The Glass Industry

Copyright, 1922, by Glass Industry Publishing Company, Inc.

Vol. 3 NEW YORK, APRIL, 1922 No. 4

Some Aspects of Science Applied to the Glass Industry

By C. H. KERR

Written for THE GLASS INDUSTRY

It is a generally accepted fact that the application of scientific knowledge and scientific laws to the production of glass has scarcely begun. It is indisputable that important scientific advances have been recorded within the past decade or two, but in retrospect from a period a few decades in the future there is little room for doubt that the present will be looked back upon as a period when the application of science was just beginning.

In the typical glass plant of today, the rule-of-thumb still holds full sway and the man of scientific inclinations is viewed with suspicion in his juggling of the sacred formulæ and there still remains a deep suspense during the actual working out of the changes or allowances which science has directed.

And this attitude is not without reason. The factors entering into any problem of glass manufacture are multitudinous and there is always the chance that one or more of these important factors has been overlooked. Until the final outcome is a demonstrated fact there is much skepticism and misgiving, and not infrequently the results justify the misgiving. Such a typical situation does exist and until it is replaced by an assured, matter-of-fact control over the processes entering into the production of glass manufacture, the present embryonic condition in respect to the application of science and of scientific control and development in the glass industry will continue.

Undoubtedly the lack of well-trained men has played its role of great moment. In comparison with the tremendous difficulties and complexity of the scientific problems involved, the number of men with anything approaching an adequate training has been lamentably small. So small an army of prepared workers could hardly have been expected to attack the multitudinous and difficult problems with any great hope of complete mastery. The small band of workers have done wonderfully well and much foundation work of a basic and fundamental nature has been produced.

Coincident with this lack of well-trained men has been the proportionate lack of suitable educational facilities. Training in the fundamentals of science, first of all, and subsequently a special training in the application of scientific laws to the silicate and other reactions and procedures that are involved in the formation of articles of glass require an educational organization primarily and then an equipment and facilities of broad scope and great completeness. It is only within a very few years that any educational facilities along the line of scientific glass manufacture have been available and, even at the present time, the facilities are pitiably small in comparison with the need as measured by the difficulties and discouragements that must be overcome. It is to be ardently hoped that the start which has been made in providing the sorely-needed educational opportunities will be properly appraised and the organizations and facilities accordingly augmented. Until the educational facilities are developed to a point far in advance of their present status, it is expecting too much to have the scientific problems confronting the glass manufacture adequately handled. Our few educational institutions at which attention is now being directed toward the problems of the glass maker, are doing an excellent work but their growth must be greatly accelerated in order that the problems may be successfully met.

Can anyone doubt that the great lack of technical, or even semi-technical, publications dealing with glass making has, in the past, had its important part in maintaining the status quo of scientific undevelopment? The technical trade publications in other branches of industry and commerce have unquestionably been very important factors in the stimulation of scientific development and both directly and indirectly they have been important factors in the forward march of scientific development in their respective fields. Unfortunately, in the field of glass manufacture there has been until the present time almost no scientific or technical press. One or two of the purely trade journals have made very commendable attempts to develop the technical or scientific phases of their service, but apparently there has, heretofore, been little or no demand to which to cater and the process of education to create such a demand is one of staggering proportions.

It is certainly a most auspicious sign that at the present time attempts are being made to produce this much-needed technical trade literature. The indications point to success in the efforts and to the building up of a groundwork in periodical literature which is a very essential adjunct to a strong and continuous scientific advancement.

Perhaps it is but a different statement of the same dis-

advantageous situation to call attention to the lack of scientific organizations dealing with the problems of the glass manufacturer. In these modern days of associations and societies for every conceivable and many inconceivable purposes, any field of endeavor that is without its organization, or many of them, is automatically classed as very backward. Such has been the history of the application of science to glass manufacturing. That is especially true in its application here in the United States and only in a lesser degree true in the countries across the ocean.

It was only three years ago that the Glass Division of the American Ceramic Society was organized and previous to that time there existed no scientific organization in this country devoted to the glassmaker's problems. The American Ceramic Society had previously shown a parental interest in the science and technology of glass making, but the connection was a rather promiscuous one until the Glass Division was formed. Fortunately, the Glass Division now offers an excellent clearing house for the activities of organized scientific development and it will doubtless play an important role in the utilization of scientific knowledge in the making of glass. The scientific organization has ever proved to be an important factor in the development of an industry.

In passing there is one unfortunate fact to which attention may well be called, though in many ways it seems wholly insignificant. Nevertheless, it has excited a considerable and unfavorable influence and should not pass unnoticed. There has been an unquestioned tendency on the part of many so-called glass chemists to pose as sources of all true information and failing to carry through their share of the burden with satisfaction, they have brought unmerited discredit to scientific men and especially to the value of such men in the working out of the problems confronting the glass manufacturer. Destructive criticism is about the cheapest thing on the face of the earth and about the only thing that has escaped infection during the present economic upheaval. And the ability to calmly judge situations and patiently withhold criticism until a reliable curative prescription can be advanced is a rare human quality. Perhaps the glass industry has not suffered more than other industries in this respect. It may be only another illustration of the logic in the argument that married men do not live longer than single men. It only seems longer. It does seem, at least, that an undue proportion of "glass chemists" have in past years posed for what they were not.

Fortunately, there has been a considerable number of men with scientific training who have entered the glass industry with the realization that their method of attack via scientific pathways was a helpful supplement to other methods of study and that the old practical glassman held a wealth of valuable information gleaned from his many years of careful observation. Such an attitude coupled with a well-grounded educational preparation is the only basis from which developments of much value can be expected. The other type of "glass chemist" should soon become extinct and there seems to be ample indications at hand that specimens are already becoming rare.

One very considerable difficulty that has constantly beset the pathway of the scientific worker engaged in experiments upon glass is the difficulty of deducing from small scale experiments the proper conclusions as to what may be expected in larger scale operations, or in commercial production. It is one thing to demonstrate a given fact or principle in small crucible experiments. It is quite another thing to carry the same thing forward in a melting of commercial size. Besides the influence of the very important laws of mass action, a discussion of which would be highly technical and quite beyond the confines of this article, there are the many and intricate variations due to the kind and amount of impurities present in the glass batch. A still further confusion results from the introduction of various impurities by partial and selective solution of part of the pot, or other refractory container in which the glass is melted.

Results obtained from experimental work thus far carried out in connection with glass manufacturing problems would seem to warrant the conclusion that intermediate stages in experimentation may well be dispensed with. The initial researches and experiments carried out in small laboratory quantities and under the most exact regulation of all conditions should be carried to such completion as to warrant full confidence so far as that may be obtained in advance of the actual demonstration of large scale production. Then having fully completed the purely laboratory stage of development, the next step is a trial in commercial production. The intermediate, semi-practical trials are apt to be misleading as frequently as they are helpful and reliable in their indications. There are doubtless cases in which an intermediate trial is advisable or even essential, but generally speaking, the logical progress is from thorough and accurately controlled laboratory researches to full scale commercial application. And even with the most careful and thorough work possible under conditions of today, a certain percentage of failures is to be expected.

A further confusing factor which has not received the attention it deserves is the incompleteness of chemical reactions which are due to take place in a very thorough burning of the clay pot or tank blocks. Even under the most careful conditions of manufacture, the refractories used as glass containers are very inhomogeneous masses, and the reactions that accompany burning have been arrested while still very far from completion. In the ordinary glass house refractories, and especially in the poorer ones, these reactions are only well started. There is a constant and progressive change accompanying increase in age of the pot or tank.

Such changes would be of far less consequence if they were not intimately associated with the reactions involved in the melting of the glass batch within the refractory container. All of this must be taken into careful account in the regulation and control of the glass melting. One obvious recourse is in the thorough and suitable burning of the refractory, but even under the best of conditions, this problem of the incompleteness of the reaction within the refractory container itself is one of great importance.

Perhaps the greatest handicap against which scientific workers have had to contend in studying the silicates is the problem of high temperatures. First of all, there has been the great difficulty of satisfactorily measuring the temperature and it is only within a comparatively few years that accurate and reliable estimation of the temperatures involved in glass melting has been possible. Next is the great difficulty of

attaining and maintaining uniform distribution of heat at the high temperature and, finally, there is the real problem of studying what actually takes place at those elevated temperatures.

It has been maintained by some, and there is much logic in their contention, that there is in effect a whole new field of chemistry and physics at high temperatures. To what extent do silica and certain of the silicates act as solvents, at the high temperature condition, in a manner quite analogous to the action of water as a solvent at ordinary temperatures? Such fundamental questions are at the very base of correct knowledge of and control in silicate production. But the difficulty of the high temperature investigations is tremendous and, until the last decade or so, there were no adequate facilities for carrying on such investigations. In many cases the empirical studies based upon measurements of properties possessed by the bodies after cooling are wholly inadequate and not infrequently are actually misleading.

It would not be difficult to continue the recitation of handicaps in the way of scientific and technical advancement in glass manufacturing, but a few of the prominent ones have been mentioned. There is an additional one, however, that should not be passed by. Whether it is a case of scientific inactivity of the past, or an effect of such inactivity might be open to much discussion, but it seems unquestionable that there is an intimate association between the backwardness of scientific development in the glass industry and the low average financial return upon capital invested in the glass manufacturing concerns of the country. It is quite true that some glass firms have been highly profitable, but for every one of unusual prosperity, there are probably fifty of little or no earning capacity. In general, prices of glass products have always been down pretty close to the cost of production and the margin of profit has ordinarily been so low that unusual investments, even where there was considerable assurance of good return later, could not be made. This condition, which has been quite typical of the glass industry, has certainly been an important factor, whether it be as cause or as effect. Some of our more successful glass concerns are now making considerable investments in facilities and men to carry on well-directed scientific investigation and a few of them have been at it hard enough and long enough to have realized good dividend returns from their investments. There is no better incentive to further investment than a good return from a previous one and the lesson is making itself felt even in our scientifically-backward glass industry. Some highly important results have been achieved, others are in the making and countless others are yet to come.

The Properties of the Lime-Magnesia Glasses and Their Commercial Application*

Prof. W. E. S. Turner, in addressing the October meeting of the Society of Glass Technology at Sheffield University, elected to deal with THE PROPERTIES OF THE LIME-MAGNESIA GLASSES AND THEIR COMMERCIAL APPLICATION.

As has already been intimated, the communication was a most interesting one, and it may be taken as a kind of sequel to a previous address on the subject of the soda-lime glasses, which, as the professor pointed out, are commonly used in this and other countries, and represent probably 95 per cent or more of present-day, essentially-commercial glassware. Various research chemists at Sheffield University have, however, recently been making investigations into the properties of glasses containing magnesia instead of lime, and although the utility of these investigations may not be instantly apparent to everyone connected with the glass trade, it is obvious that they have been pursued with clear and definite intentions, and that they have resulted in the elucidation of certain points about which it is well that every glass manufacturer should be clear.

The lecturer pointed out in the first place that the glasses of commerce—the soda-lime glasses, which are produced in huge quantities—have been adopted for certain specific reasons, one of the most important, probably, being that such glasses are cheap. The materials from which such glasses are made are, all of them, easily accessible, and can usually be obtained at a comparatively low price. At the same time, he said, it should be emphasized that there were certain particular advantages attending the use of lime. Lime was a constituent of glass which, as a flux, had been utilized as far back as one could trace into the history of glassmaking. The earliest Roman glasses were largely lime-soda glasses, and no one yet, so far as the lecturer was aware, had made commercially corresponding glasses of soda-magnesia. Such glasses, however, if they could be made, would no doubt have certain properties of distinct value. The question arose: Was it possible to obtain any of the advantages which such glasses might offer by getting rid of some of the difficulties and disadvantages which were encountered in their manufacture?

The first difficulty was, undoubtedly, that magnesia was not easily obtainable in bulk, and then only at a price which was far outside that which could make it capable of being used in times such as the present. In the production nowadays of glassware—especially in anything like mass production—there were certain elementary facts which the manufacturer must always keep in mind. Amongst these was the question of supplying, either to the hand-workers or to the machines, a glass which was capable of being melted as easily as possible, in order to ensure a continuous supply of metal. In the case of machine operations this was particularly important. For this purpose, although soda-lime glasses were still adhered to, they had been changed lately in such a way that melting had been rendered easier. The glass was usually very soft. This had been brought about by putting in a larger and larger amount of alkaline constituent—otherwise expressed, soda—and thereby reducing the lime. This had not really improved the properties of the glass as a whole,

*From *The Pottery Gazette and Glass Trade Review.*

although it had rendered it more amenable to the melting process. Besides the question of melting, however, there was the question of manipulation. The glasses must suit the method of manipulation, and they must suit particular machines. Time and time again, during the past year, the lecturer said, he had been trying to drive home in factories the point that modern machines could only take a certain type of food; otherwise they would be given indigestion, in which case they would not work properly, and the rate of production would be impaired. The glass must have a certain working property—plasticity, viscosity, or whatever else one might like to call it—which was best suited to its manipulation.

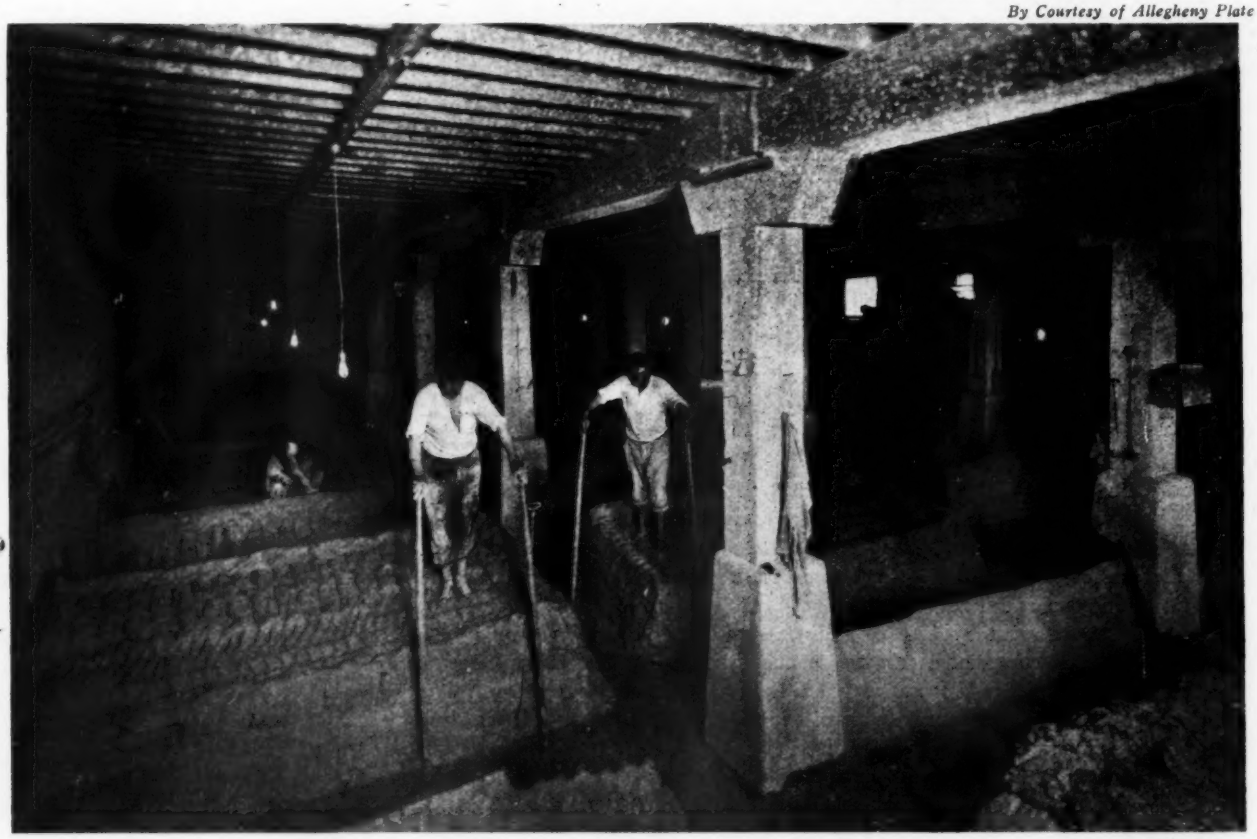
After deciding the question of the most efficient manipulation, one had further to consider the annealing of the glass. Here, again, the main idea was to get an article which was capable of being annealed at the lowest possible temperature, because the "lowest possible temperature" meant the minimum consumption of fuel on the lehr. Further, one would like to be assured that the glass, while passing down the lehr, should not be so susceptible to a change of temperature that it would be readily liable to fracture. This might be secured in various ways, one of these being the manufacture of a glass of a comparatively low coefficient of thermal expansion.

Bearing in mind some of the points already enumerated, the magnesia glasses certainly seemed to offer some advantages. They were different in their properties from the lime glasses. Experiments had shown that as one increased the amount of lime in a lime-containing glass the glass became more and more difficult to anneal. That might be expressed in another way, viz., the higher the percentage of lime content, the hotter and hotter must be the lehr employed. In the case of magnesia, however, the annealing curve rose much more steeply. If articles of glassware, as they came down the lehr, were suddenly chilled, owing to the fact that the belt or pan had become cooled, either through not being efficiently heated or through being subjected to a draught, it would be found that a magnesia glass had a great advantage over a lime glass through the former having a much slower rate of expansion. If, therefore, the glass were suddenly cooled, the magnesia glass would contract very much less and be much less liable to fracture.

Modern Methods of Making

A Series of Interior Views

By Courtesy of Allegheny Plate



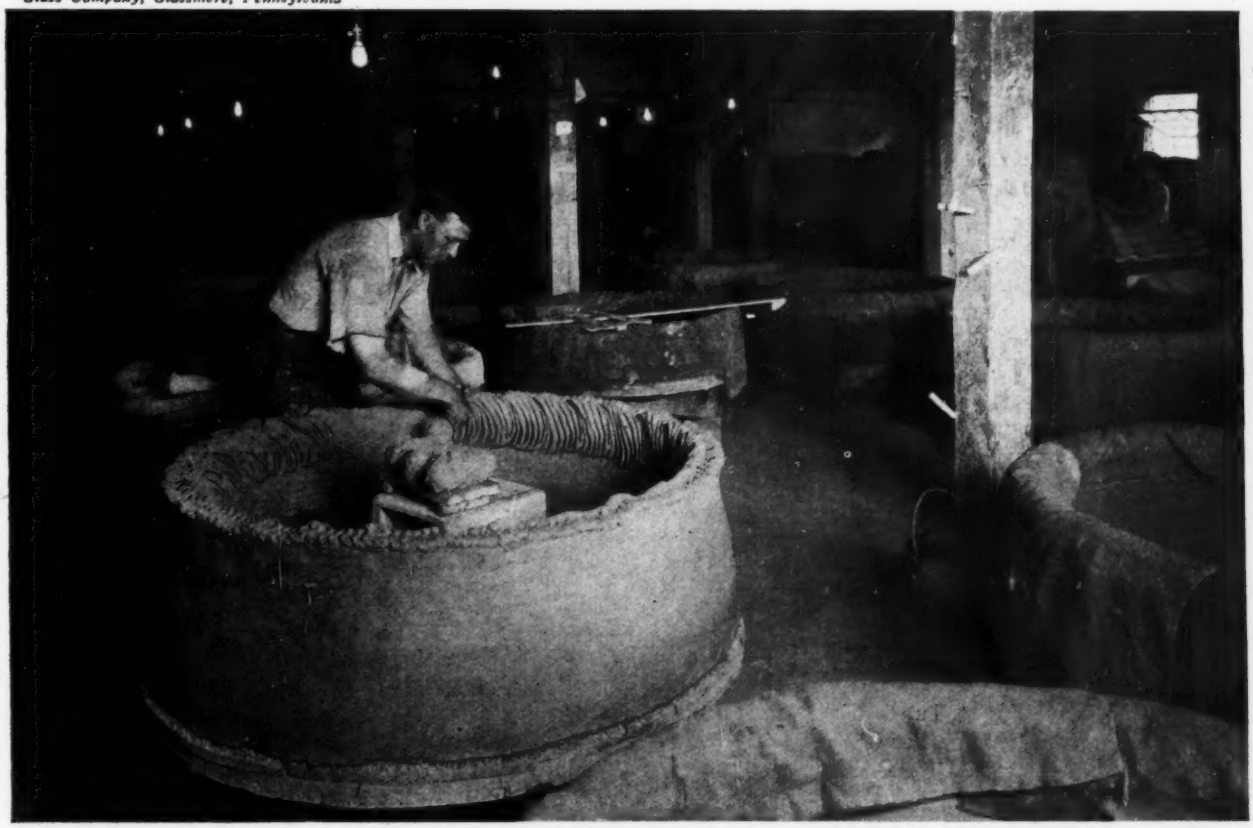
2. Tamping the Clay for the Melting Pots. Long continued experimenting has firmly demonstrated that hand built pots of clay are the best containers for the fusion of plate glass metal. Clay of the highest quality obtainable is used and is here shown being tamped. Tamping one batch takes sixty days, because slow and repeated working of the clay is necessary to exclude all air pockets and to obtain the proper moisture content and consistency. Kneading layer upon layer with their bare feet, the workmen transform raw, crumbly clay into a malleable mass, suited for the molder's hand.

In testing a number of glasses in order to find out how the properties changed where both lime and magnesia were present, a series of slides had been prepared by the lecturer which showed the effect of the gradual substitution of magnesia for lime. The tests began with a glass containing all lime and no magnesia; magnesia was progressively added and the lime reduced, until ultimately a glass was reached which contained all magnesia and no lime. What was the result? It was found, in the first place, that when small amounts of magnesia were put in, the glass melted much more readily in the case of an all-lime glass—the silica and the soda remaining fairly constant—the temperature required was 562 deg. C. But as soon as magnesia was introduced there was a big drop in the requisite annealing temperature, and as more and more magnesia was introduced there was a still further slight drop, until, ultimately, a figure as low as 514 deg. C. was reached. While the all-magnesia glass had a lower annealing temperature than the corresponding all-lime glass by some 17 degrees, a mixed lime and magnesia glass could be annealed very much more readily than either the all-lime

Plate Glass Illustrated

of a Successful Factory

Glass Company, Glassmere, Pennsylvania



3. Building Up the Pot. For plate glass making purposes the clay pot is not equalled by any substitute. It takes fifteen days to complete one pot. The building must be gradual and careful, layer knit to layer. There must be no air holes, fault lines, nor incipient cracks. The intense heat to which they are to be subjected would soon change a slight defect into a serious leak, rendering the pot worthless and the contents wasted. But the workmen are highly skilled, and faults seldom develop. After completion the pots are permitted to dry, which takes from sixty to 100 days, depending on the season of the year and other conditions.

than when only lime was present or only magnesia. This was not at all an extraordinary physical phenomenon, but glass manufacturers might find it interesting nevertheless. Small amounts of magnesia improved the rate of melting and planing, and softened the metal considerably, but where large amounts of magnesia were introduced, the difficulties in the direction of melting were increased.

In regard to the annealing of the finished articles, investigations had been made into the question of the temperatures at which it was necessary to maintain the lehrs in order to ensure satisfactory operation. It had been determined that, glass, which was the common article of commerce, or the all-magnesia glass, which no one had ever thought of trying to make commercially. The minimum practicable annealing temperature, therefore, would seem to be about 514 deg. C. It had already been determined, then, that the addition of small amounts of magnesia to a glass assisted, firstly, in the melting and fining of the glass, and secondly, in the annealing—two very important considerations.

One or two other observations bearing on the practical side might be useful. The working properties of the glass being improved by the course indicated, it was possible to

melt the glass at a lower temperature, and thereby save fuel. Magnesia-lime glasses had recently been adopted for special purposes; for instance, they had latterly come into use in America in the manufacture of electric lamp bulbs. This might conceivably have some bearing upon the production of ordinary glassware containers. Again, it had to be borne in mind that a magnesia glass was not so readily devitrified as a glass containing all lime, and for this reason it might be possible to employ a glass containing rather more magnesia than the glasses commonly in use at the present time for automatic machinery, where the lime content had been reduced to comparatively small amounts as compared with the older glasses. The durability of the glass would be increased thereby, and almost assuredly also the strength of the articles that were made. If, at the same time, the glass were sufficiently softened, as would appear to be the case in the experiments which were the subject of the present communication, glass-feeding devices would become capable of delivering the metal much more readily, and the risks of stoppage in the delivery apparatus would be considerably reduced. It would seem, therefore, that the theoretically possible advantages were worthy of consideration.

Finally, one might ask, was a magnesia glass a practical proposition in a glassworks making such prosaic lines as bottles and containers? The main difficulty was, as stated at the beginning, the limited sources of supplies of magnesia.

Similarities Between Hot Glass and Hot Metal*

Glass may be readily examined ultramicroscopically, and a consideration of the phenomena observed in glasses will serve to give some insight into what occurs in metals and alloys.[1]

Among glass technologists a molten batch of glass is termed "metal," a term remarkably well chosen, for, strange as it may appear, there are numerous analogies between glasses and most metals. Both are produced or fused at high temperatures, and as they issue from the furnaces are, for the most part, heavy viscous liquids[2] prone to set and crystalize. Both exhibit the phenomena of supercooling to a marked degree if quickly chilled. Both may be cast, molded, pressed, drawn and annealed or tempered—they are in fact thermoplastic and their physical properties are largely dependent upon their thermal and mechanical histories. There are, of course, many enormous differences between glasses and metals, and very marked differences exist even in their analogous properties. Thus with metals the crystallization tendency is powerful and quick acting, whereas with glasses the composition is generally chosen so as to prevent crystallization under operating conditions, some of the constituents of glass apparently serving as protectors or inhibitors of crystallization toward the others. Furthermore, metals tend to cool much more rapidly than glasses because of their greater thermal conductivity; but their rapid crystallization usually outstrips their chilling, notwithstanding the fact that the latter is often facilitated by quenching.

Behavior of Supercooled Melts

As Tammann has shown,[3] there are three main factors which control the behavior of supercooled melts: (1) The specific crystallization capacity (which is measured by the number of centers of crystallization formed in a unit mass in a unit time); (2) the speed of crystallization; (3) the variation in viscosity. In the case of the various mixtures of fused silicates composing molten glasses, the viscosity increases so rapidly upon cooling that the crystallization forces are unable to establish themselves before the melt becomes too rigid to permit molecular orientation. The result is the amorphous, or colloidal, mass we call glass. In very quickly cooled glass—i. e., Prince Rupert bubbles—the internal strains are so great that the glass is actually explosive; and in the ordinary process of manufacture glass has to be annealed to render it less brittle. This is accomplished by cooling the glass very slowly, keeping it at a low heat for a long time so that there may be a partial adjustment of the aggregation tendencies of its particles. Gelatin jellies act similarly, but, because of their softness, anneal spontaneously at room temperature.[4] Thus F. Stoffel[5] has shown that quickly cooled gelatin jellies permit the more rapid diffusion of electrolytes than slowly cooled jellies; but the difference equalizes itself after several days. Incidentally this shows the higher dispersion of the particles in the quickly cooled jelly and the greater total area of diffusion paths.

If the composition or heat-treatment of the glass is such that crystallization occurs, we call the phenomenon devitrification—the glass becomes cloudy or opaque. The inherent tendency toward crystallization exists even in clear glasses, and may be realized after a very long lapse of time. [The composition of opaque glasses is so chosen that under usual conditions a turbidity is produced, a fine precipitate which renders the glass opaque. Recently James Gillinder, of Port Jervis, N. Y., was kind enough to make for me some Prince Rupert drops from a batch of opal glass. The exterior rind of the drops was clear or showed a faint turbidity, whereas the interior, which was of course more slowly cooled, was milky and opaque. At the surface the chilling was from about 1,200 deg. down to 15 or 20 deg.] Thus ancient Egyptian and Roman glasses are frequently found to be devitrified. On the other hand, although old leaden roofs consist of metal showing coarse crystals, ancient iron shows practically the same structure as modern iron. We must remember that iron as a rule consists mainly of the crystalline phase, which is stable, not of the colloidal phase, which is metastable and can undergo slow hysteresis; besides, iron does not undergo annealing at ordinary temperatures.

Gold Ruby Glass

The work of Zsigmondy, on gold ruby glass,[6] has given us an understanding of what happens when a metal is dis-

*Jerome Alexander in *Chemical and Metallurgical Engineering*, vol. 26, No. 2, p. 56.

[1]For results of ultramicroscopic examination of quickly and slowly chilled soaps, see J. Alexander, *Trans. Am. Inst. Min. Eng.*, 1919; *J. Soc. Chem. Ind.*, 1909; *Trans. Am. Inst. Chem. Eng.*, vol. 2, pp. 210-228 (1909).

[2][Truly liquid metals have a low viscosity. See Abstract of Prof. T. Turner, *J. Soc. Chem. Ind.*, vol. 40, p. 190R (1921.]

[3]*Z. Elegtrochim*, vol. 10, p. 502 (1904).

[4]So do soft metals; lead and tin, for example.

[5]See H. Bechhold, "Colloids in Biology and Medicine," p. 52 translated by J. G. M. Bullowa, (D. Van Nostrand Co., 1919).

[6]"Colloids and the Ultramicroscope," (translation by J. Alexander.) John Wiley & Sons Co., 1909.

persed in glass. When gold is added to a glass melt (usually 1 part of gold chloride to from 3,000 to 10,000 glass), it dissolves, and the molten glass is colorless and upon slow cooling may become red or remain colorless, depending upon the nature of the batch. If quickly cooled to a set, all grades of gold ruby glass remain colorless. Upon reheating colorless ruby glass to the softening point, a portion of the dissolved or molecularly dispersed gold separates out upon nuclei or crystallization centers already formed in the previously chilled mass, and the glass usually develops its normal red color. Spoiled batches, upon reheating, generally yield a blue or violet shade, but may yield an unsatisfactory red. Reproduced in Table II are the ultramicroscopic observations of Zsigmondy made upon good and upon spoiled ruby glass, using bright sunlight and a homogeneous immersion objective. Both specimens had been slowly cooled and then reheated more quickly than they had previously been chilled, they were heated so that at one end they began to melt (hot end), whereas at the other end they remained cold (cold end).

TABLE II.

Hot End	Good Ruby Glass	Spoiled Ruby Glass
Color Red Decreasing ↓		Color Decreases ↓
a	Color intense red. Numerous green ultramicrons, very close together, their brightness diminishing. ↓	Color blue. Ultramicrons fewer, copper-red, further apart.
b		Color violet. Ultramicrons yellow.
b'	Homogeneous green light cone.	
c		Color bright red. Ultramicrons green.
d	Colorless and homogeneous.	Colorless. Few faint specks visible.
Cold End		

That with these particular specimens no new crystallization nuclei were formed upon reheating is evident from the fact that the average distance between the ultramicrons was the same in the intensely heated portions as in the less heated portions of the glass. "Colorless, slowly cooled gold ruby glass contains one part of its gold, therefore, in supersaturated solution, and the remainder in the form of nuclei so small that they affect the homogeneity of the glass only slightly or not at all. With batches of different composition, the temperature for the spontaneous formation of nuclei is so much higher that such glass colors up red on slow cooling."

Applying these principles to technical practice, Zsigmondy was able to explain certain heretofore incomprehensible observations. Thus, "The rim of a piece of pressed ruby glass remained colorless, while the middle became red. In the press the rim was more quickly cooled than the middle, and by subsequent heating was heated more quickly and to a higher temperature. Investigation showed that the rim contained a much lesser number but considerably larger green gold particles than the rest of the glass. The rim of the glass had very quickly passed through the optimum temperature for the formation of nuclei, so that only few were formed; subsequent heating to a higher temperature, therefore, led to a speedy growth of these nuclei into particles of 110 to 145 $\mu\mu$. The middle section of the glass had time enough to form a large number of nuclei, which, being less strongly heated, grew more slowly. In spoiled ruby glass the formation as well as the growth of nuclei is disturbed; fewer nuclei are formed and these grow more slowly than in good ruby glass."

Devitrification of Glass

Zsigmondy emphasizes the fact that the coloring of ruby glass should not be confounded with ordinary devitrification. "The difference between the two is that in the formation of ruby glass several milliards of nuclei exist and grow in a cubic millimeter, and that the hypothetical little crystals, of whose form and structure we know nothing, are so small that their presence changes only the visible appearance and not the working properties of the glass; whereas, in the case of devitrification, relatively few nuclei are present and lead to the formation of quite large crystals, which prevent the usual working up of the glass."

This difference is clearly seen on considering the facts brought out by N. L. Bowen in a recent paper[7] on the devitrification of glass. While many silicates may be cooled quite slowly without crystallizing, $MgSiO_3$, Al_2SiO_5 and $CaSiO_3$ crystallize unless quickly chilled, a condition difficult of realization because molten silicates combine high thermal capacity with low thermal conductivity. The composition of the batch must be chosen to prevent supersaturation with any component at any temperature at which the glass is to be subsequently maintained. If devitrification occurs when the glass is cooled preparatory to working (or prior to the final stirring in the case of optical glass), the crystals formed are usually large. When the glass is cooled from the plastic to the rigid state, as during blowing, drawing, casting and particularly when optical glass is being cooled in the melting pots, devitrification may occur through the separation of spherulites or minute crystals uniformly disseminated throughout the glass, making it opalescent. Microscopically these crystals were found to be trydymite and cristobalite in most cases investigated. Particularly interesting is the fact that their formation is facilitated by "mineralizers" such as SO_3 or Cl; arsenic acts similarly if in excess, and fluorine may do so. This reminds one of a "salting out" action; the opposite or protective action of constituents in a melt is illustrated by the facts brought out in a paper[8] by H. F. Bellamy on gold ruby glass. His results show that SnO_2 acts as a powerful protector or stabilizer, deepening the color of the glass to such an extent when added in optimum proportions that the percentage of gold present has to be diminished.

The tin also keeps the color uniform over a range of reheating temperatures and prevents the development of light blue, purple or rose colors (which are indicative of coagulation or undue aggregation).

We have here a typical instance of protection in the colloidal sense, which is quite in line with the work of Zsigmondy,[9] who showed that the purple of Cassius (an ammonia-soluble deep red precipitate obtained by mixing solutions of chloride of gold and stannous chloride) is simply colloidal gold stabilized by colloidal stannic acid. Berzelius regarded the purple of Cassius as a chemical combination of tin sesquioxide and purplish oxide of gold, and Gay-Lussac, Debray, Müller and others contributed to the extensive literature concerning it. Zsigmondy settled the moot question, for he actually synthesized the purple of Cassius by mixing together the hydrosols of gold and stannic acid, thus proving it to be an adsorption compound of the two.

[7] *J. Am. Ceramic Soc.*, vol. 2, pp. 261-281 (1919).
[8] *J. Amer. Ceramic Soc.*, vol. 2, pp. 313-322 (1919).
[9] Colloids and the Ultramicroscope, p. 65. E. A. Schneider anticipated Zsigmondy, whose discovery, however, was made independently.

American Society of Testing Materials' Recommended Specifications for Quicklime and Hydrated Lime

For Use in the Manufacture of Glass

To permit of comparison being made with the Recommended Specifications of the Bureau of Standards (see March issue) those recently adopted by the American Society of Testing Materials are given here. The methods recommended by the American Society of Testing Materials for the sampling and testing of lime are not included as these operations have already been adequately covered in the Bureau of Standards bulletin and in "The Laboratory" section of THE GLASS INDUSTRY.

1. GENERAL.

(*a*) *Definition of glass.* Ordinary glass is a vitreous congealed liquid of amorphous structure consisting usually of silicates or borates of an alkali and an alkaline earth element which in the molten state exist in the form of mutual solutions. Admixtures of certain oxides such as iron and zinc may be made to secure special properties.

(*b*) *Basic raw materials for glass manufacture.* Of the alkalis, sodium and potassium are the only ones which are used to a large extent because the others are prohibitively costly. For the same reason, calcium and magnesium oxides are the only alkaline earths which are used on a large scale.

(*c*) *Sources of alkaline earth bases.* The usual sources of the alkaline earth bases are limestone, hydrated lime, quicklime and dolomite.

(*d*) *Definition of quicklime and hydrated lime.* Quicklime is a product resulting from the calcination of limestone or dolomite. It will slake when water is added to it, and this slaking is accompanied by an evolution of heat and an increase in volume. It consists essentially of calcium oxide or of calcium and magnesium oxide.

Hydrated lime is a dry powder, which is made by treating quicklime with enough water to satisfy its chemical affinity. It consists essentially of the hydroxides of calcium and magnesium.

2. REQUIREMENTS.

(*a*) *Quality.* Although glass may be successfully made from hydrated limes and quicklimes which vary widely in their composition, yet it is important that the composition be constant and uniform from day to day; otherwise, the difficulty of controlling the process of manufacture becomes too great. It is necessary also that these raw materials be in a fine state of division. Hydrated lime as shipped is sufficiently fine but quicklime should be ground.

(*b*) *Composition.* Quicklime should not contain more than five per cent CO_2 as shipped. Hydrated lime should not contain more than eight per cent of CO_2 as shipped. The purity of the lime required for the various kinds of glass varies within wide limits. Optical glass requires a very high degree of purity and uniformity. Bottle glass, on the other hand, may be made satisfactorily with very impure lime. The purity requirements for sheet glass, blown or pressed glass, and rolled or plate glass fall in between the two extremes represented by bottle glass and optical glass.

While either high calcium or high magnesium lime can be used for the manufacture of glass, it is essential that the relative proportions of calcium and magnesium oxides shall not vary greatly from day to day. Although the per cent of calcium oxide is left to be established by contract, it is specified that the CaO content of the non-volatile portion shall not vary more than 4 per cent in lime for bottle, sheet and crown glass, 3.5 per cent in lime for blown or pressed glass, 3 per cent in lime for rolled or plate glass, and 2 per cent in lime for optical glass.

To conform to the requirements for the various kinds of glass the constituents of the lime listed below should not exceed the maximum percentages nor fall below the minimum percentages in the following table:

Composition of the Non-Volatile Portion of Quicklime or Hydrated Lime.

Ingredients	Bottle Glass	Sheet or Crown Glass	Blown or Pressed Glass	Rolled or Plate Glass	Optical Glass
CaO and MgO (minimum)	89.00	91.00	93.00	96.00	97.00
Ferric oxide (maximum)	1.00	.75	.50	.20	.08
Sulphuric and Phosphoric anhydrides (maximum)	1.00	1.00	.10	.80	.20
Silica (maximum)	15.00	10.00	6.00	3.00	1.50
Alumina (maximum)	5.00	4.00	3.00	1.50	.75

Penalties for nonuniform or inferior material as well as premiums for uniform material or material of superior quality are left to be established by the contracting parties.

(*c*) *Fineness.* Unless otherwise specified, limestone, quicklime and hydrated lime shall be crushed so that all will pass a No. 10 sieve, and may be crusher run material.

(*d*) *Packing.* Quicklime is shipped either in bulk, in carload lots, in barrels holding 180 pounds net or 280 pounds net each, or in bags of 80 pounds net each. Hydrated lime is shipped in paper bags holding 50 pounds net each.

(*e*) *Marking.* Each package, or each carload of bulk material shall be legibly marked with the names of the consignor and consignee, and with some means of identifying the particular contract on which the shipment is made.

This information is in addition to that required by the Federal lime-barrel law.

Echoes from the American Ceramic Society Meeting

Time and lack of space prevented the publication in the March number of a complete summary of the papers presented at the annual convention of the American Ceramic Society at St. Louis, Mo., in February.

Papers not reviewed in that issue are summarized below and various items of news received too late for insertion in the March number are given.

It was decided that the twenty-fifth annual meeting shall be held in Pittsburgh in 1923.

All of the society's editorial work is to be taken care of hereafter by the secretary's office. Secretary Ross C. Purdy is to be editor of the *Journal* during the current year.

James D. Lalor, of Baltimore, Md., discussed fuel oil systems, their installation and operating problems.

Loss of heat through furnace walls was the subject treated by R. M. Howe, of Mellon Institute of Industrial Research. Tests showed that the pressure of the furnace gas and the penetration into the walls of the hot gases is a factor that must be reckoned with.

Prof. K. H. Endell, of the university at Charlottenburg, Germany, described German methods of testing silica brick. He invited the members of the American Ceramic Society to attend a meeting of a recently organized German ceramic society next June.

E. N. McGee spoke on the relationship between the hot and cold modulus of rupture for silica brick.

During the discussion of Prof. Arthur S. Watts' paper on the conductivity of commercial refractories, it was pointed out by A. F. Greaves-Walker that with the increasing use of oil, gas and powdered coal in connection with air under pressure, temperatures exceeding 3000 degrees C. frequently occur, and this necessitates drastic reductions in the thickness of furnace walls sometimes amounting to more than one-half, to provide for the escape

of the heat, this, under present conditions, being the only means of obtaining the desired reactions without destroying the refractories.

The Handling, Storing and Setting of Glass Pots

W. M. CLARK and J. H. FORSYTH.

That a body of clay weighing around one and one-half tons molded and shaped and carefully dried will stand the rough treatment necessitated in shipment is remarkable. A water tight box car should be selected for shipment of the pots and pots should be set on dry packing hay and well braced so that they cannot shift position or be jarred during transit.

Pots should be raised upon removal from the car by yoke or block and tackle, to level of pot carriage. The carriages should be well padded, spring suspension and roller bearings are recommended to avoid jolts and jars when crossing rough places. Careless handling is very hard to trace as the direct cause of pot failure.

Pots should be stored in a dry place fenced off with wire netting and locked. Bottoms should be raised on blocks and pots so arranged that oldest pots are used first. Cards should be kept to show the makes, maker's number, furnace number, arch number, how broken, remarks, when set. Summary sheet should show number of pot and maker's name, date set, date broken, life, melts and how broken.

Where large numbers of pots are used mechanical or power driven carriages are recommended. Storage in a room constructed alongside of checker chamber enables pots to be dried out by waste radiated heat, and be warm when set in pot arch. This plan has been successful at one plant. There is no other tool worth one hundred dollars around a glasshouse but that receives better care than is usually given a pot, yet the pots are the mainsprings of the business.

Pot setting requires a well trained crew. Sheet metal doors should be removed and an old set substituted during this procedure. Chain screens or wire gauze screens are advocated for protection of workmen. Care in getting the bench absolutely clean and keeping it so eliminates trouble in the future. Care should be taken to have enough or more than enough sand under the back of the pots when set. Too much sand is easily remedied by shifting the pot from side to side, but it is almost impossible to get additional sand under the back of pot, once the pot is settled. Pot should be set level. If metal is not all worked out from pots they may be tilted somewhat and thus relieve strain at back of pot from pressure of the glass. Taking the greatest pains is advocated in all handling of pots. Plants pursuing careful methods prove that the results attained will justify the precautions taken.

Disintegrating Action of Water on Soda Lime Glass

ARTHUR E. WILLIAMS.

In his talk, Mr. Williams illustrated with lantern slides the effect on glass ware of continual immersion in boiling water. The sterilizing of milk bottles, and the washing of tumblers in large establishments, such as restaurants, hotels, etc., causes the development of small chips or spalls in the glass and fine hair cracks.

Continued boiling of the articles or intermittent treatment produce the same effect. Continued boiling shows results in the shortest time. The effect is accumulative until the specimen fails by cracks first starting on the outside and gradually becoming larger and deeper until the center is reached. Solubility of the glass is not a true indication as to how the glass will fail in this respect. Perfect annealing will lessen the trouble. Glassware subject to the spalling and cracking is very much weakened in mechanical strength after one or two treatments such as sterilizing of milk bottles.

Autoclave tests are very severe on this type of glass, much more so than mere boiling. The effects are so pronounced that boiling for six hours is advocated as a standard test for milk bottles, tumblers, etc., which are subject to similar treatment in ordinary use.

Mr. Williams also described the trouble which is experienced in storing such ware due to surface corrosion caused by moisture and stated that investigation is now being carried out to determine the exact cause of this trouble and if possible some means of eliminating it.

The Evolution and Development of Glass House Equipment

By J. S. HERZOG.

(Not listed on program)

This paper was an historical résumé of the development of mechanical devices for glasshouse use, fuels from wood to fuel oil, handling of raw materials, furnaces, gathering devices and their requirements, molds for blown and pressed ware and the metals used in their construction, machines for making molds, carrying-in devices or conveyors, annealing lehrs, polariscopes, pyrometers, grinding and etching equipment for decorative ware. By the use of these devices one manufacturer was able to state that "Our raw material and fuel enters the north end and our finished product goes out the south end. If we had a catsup factory on our south side, the bottles could be filled as they went out the doors; and no hand has touched them except for inspection."

Operation of Lehrs

By C. E. FRAZIER

Comment on this article printed in the *Journal of the American Ceramic Society* was made by L. H. Adams and further discussion solicited.

The weight of opinion of manufacturers of pressed ware seemed to show that heavy pressure at the time of molding gave rise to strains other than those caused by a chilling of the glass These mechanically induced strains were very evident when annealing, as those pieces made under large pressure, everything else being equal, were much harder to anneal perfectly.

Corrections

E. N. Bunting, who exhibited at the convention a piece of flint glass which had been melted in an electrically-wound furnace under a vacuum, has called attention to errors which appeared in the summary of his address on page 53 of the March number. The correct title of his contribution is, A NOTE ON THE EFFECT ON MANGANESE IN GLASS OF MELTING AT REDUCED PRESSURE. The pink color mentioned was on the surface of the glass, not at the bottom. It was this surface layer which contained the most bubbles of gas and was colored pink, the middle layer was white and the bottom layer green, the green layer being the only one free from gas. The statement that the gases were of a reducing nature was not made and is not correct. The only explanation given was that the differences in color were due to different states of oxidation of the manganese present.

In the review of H. T. Bellamy's paper, "A Small Glass Tank," on page 53 in the March number, the statement that the zirconium silicate bricks were supplied by the Norton Company was incorrect. They were furnished by the Carborundum Company.

Automobile Headlight Tests and Regulations.—With the idea of securing uniformity in the adoption of such regulations governing automobile headlights, an informal organization of state authorities representing the whole of New England, New York, New Jersey, Pennsylvania, and Maryland has been formed through the committee on motor vehicle lighting of the Illuminating Engineering Society. A meeting of this organization will be held at Harrisburg, Pa., in April, and it is understood that an attempt will be made to establish a board of officers who will be charged with the approval of devices in all the states represented.

The Glass Industry

The First Technical Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials, and Glass Factory Equipment and Operation.

Published Monthly by the

GLASS INDUSTRY PUBLISHING COMPANY, INC.

19 Liberty Street, NEW YORK

Telephone, John 4046 Cable Address, Glasdustry

J. B. KRAK, Technical Editor

Subscription Price.....$2.00 a Year
Single Copy.....20 Cents

THE GLASS INDUSTRY circulates extensively among American and foreign glass manufacturers, their chief executives and technical and factory operating staffs.

ADVERTISING RATES ON APPLICATION

NEW YORK, APRIL, 1922

CONTENTS

Page

Some Aspects of Science Applied to the Glass Industry..... 69
The Properties of the Lime-Magnesia Glasses and Their Commercial Application 71
Modern Methods of Making Plate Glass Illustrated.....72
Similarities Between Hot Glass and Hot Metal..... 74
American Society of Testing Materials' Recommended Specifications for Quicklime and Hydrated Lime 76
Echoes from American Ceramic Society Meeting 76
The Handling, Storing and Setting of Glass Pots..... 77
The Evolution and Development of Glass House Equipment 77
Disintegrating Action of Water on Soda-Lime Glass..... 77
Operation of Lehrs 77
Editorials:
Synthetic Fuels 78
Will Cast Glass Pots Supplant Present Type?..... 78
The Laboratory:
Analysis of Lead Glasses 80
Technical Consultation Service:
Etching of Glass 79
Relative Cost of Using Lime and Limestone..... 79
Letters to the Editor:
American Machinery Manufacturers Need Better Understanding of English Factory Conditions 81
Tar in Producer Gas Burners 82
Recent Patents 82
Glass Factory Equipment and Supplies:
The Scoop Conveyor 84
Successful Test of Lynch Model "B"..... 84
United States Trade in January 85
Annual Reports of Industrial Concerns 85
Hoover Calls Conference of Trade Associations..... 86
New Indictment Against Window Glass Men..... 86
Personals 86
Deaths 86
News of the Trade 87
Inquiries Received 87
Foreign Trade Opportunities 87
Current Prices of Glass-Making Materials 88
Market Quotations on Glass Stocks..... 88

CLASSIFIED BUYERS' GUIDE PAGE 10

Synthetic Fuels

Not long ago the newspaper reading public had the opportunity of enjoying the thrill that goes with the fulfillment of a dream which humanity has nurtured since the dawn of civilization. A prominent economist gravely discussed the influence on the established standards of value by the discovery of the manufacture of gold. The report had come from Germany that the hopes of the alchemist, which modern science has proven to be a *fata morgana*, were realized after all. Something of a panic gripped our hearts as we fancied Germany paying the indemnity with synthetic gold.

The report undoubtedly was well founded for otherwise no learned professor would write an article on its bearing on the future of humanity. Anyway, why should not it be true? Had not all our fundamental conceptions been upset in recent years? Madame Curie had divided the atom, invisible since Democritas. Einstein had changed the laws of gravity, immovable since Newton. It would not be surprising if someone discovered how to make gold. However, the joys of some and the scepticisms of others vanished after a few days, when the Geological Survey assured us that there was nothing in the reported discovery.

All this to show that if prominent men can be led to believe a yarn which was ludicrous on its face, no one should censure a manufacturer of a popular brand of motor cars for believing that a gasoline substitute can be made by adding a chemical to water. Neither should the man be despised who puts his hard earned cash in a concern which proposes to make a synthetic fuel. Since the armistice not quite so much has been heard about these marvelous sources of energy which were reported almost every week during the war. But if the coal strike should be declared, inventors are bound to get busy again.

It would not be amiss to remember that the laws of the conservation of matter and of energy are still in force in spite of the fact that some changes may have to be made to include newly discovered phenomena. So far as their practical application is concerned, the laws of nature, discovered by the great thinkers of the past, still hold good. It remains true that no one can get more heat units from any substance—or even as much—as the theoretical amount contained in the material used as a fuel. Our hope is for more efficient utilization of the sources of heat at our command at the present time, rather than for the discovery of new fuels.

Will Cast Glass Pots Supplant Present Type?

At a recent conference of representatives of optical glass manufacturers at the Bureau of Standards there was brought to the front a question of absorbing interest to pot users and of vital importance to pot manufacturers. It appears that a strong sentiment was disclosed in favor of the use of cast pots. The discussion brought out the fact that at least one American manufacturer of optical glass had been working on the problem for a number of years and has been using cast pots extensively for some time past. German manufacturers also are using them.

As a result of the experience gained during the past few years in the use of glass pots and because of increasing knowledge of proper methods of casting, it is being freely predicted by those in close touch with the situation that the cast pot will come into universal use for optical glass. Not so much progress, apparently, has been made in the adaptation of this type of pot for other types of glass.

It is interesting to speculate on the changes that would occur in the glass pot industry should future developments result in the invasion of the cast pot into other branches of the industry besides optical glass. This is precisely what is likely to happen, according to some well informed authorities.

The Laboratory

By J. B. KRAK

Analysis of Lead Glasses

This class may be subdivided into (1) crystal glasses containing silica, lead, potassium, sodium or both alkalies, and (2) semi-crystal glasses containing in addition the element calcium.

CRYSTAL GLASSES.—Estimation of silica, iron, aluminum and lead. Mix one gram of the finely powdered glass with 5 grams of sodium carbonate and add ½ gram of potassium nitrate. Proceed as described in the analysis of common glass (THE GLASS INDUSTRY, Vol. 3, No. 3, March, 1922, p. 56). Heating should proceed slowly and with a small flame at first. Plenty of air should be mixed with the gas so as to obtain an oxidizing flame. A reducing flame may cause the reduction of the lead compounds to metallic lead, which would alloy with the platinum crucible. After the fusion the mass is treated with hot water and a few cc. of nitric acid. To the filtrate from the silica, which is transferred to a porcelain dish, add sulphuric acid and evaporate to fumes of sulphur trioxide on a steam bath. Allow to cool, add water, filter the lead sulphate on a tared Gooch crucible, wash with 10% sulphuric acid and finally with 50% ethylalcohol. Dry the crucible and contents, ignite to a dull red heat and weigh as $PbSO_4$.

Calculation: Weight of $PbSO_4 \times 73.59 =$ Per Cent PbO.

Iron and aluminum are estimated in the filtrate in the usual manner, by precipitation as hydroxides.

SEMI-CRYSTAL GLASSES.—The presence of calcium in the solution, filtered from the silica, necessitates a modification of the procedure. The solution is diluted to about 600 cc. and is gassed with hydrogen sulphide until all of the lead is precipitated as lead sulphide. Filter, and estimate iron, aluminum, calcium and magnesium in the filtrate, after removal of the hydrogen sulphide by boiling. The lead sulphide is converted into lead sulphate as follows: Treat the precipitate on the filter with a few cc. of hot, diluted nitric acid (1:1) and transfer the solution to a porcelain dish. Add sulphuric acid and estimate the lead sulphate as described above.

The alkalies in lead glasses may be estimated by the method of J. Lawrence Smith (Vol. 3, No. 3, p. 57), or by the following method, proposed by Appert and Henrivaux.[1] Transfer a one gram sample to a platinum crucible and add 20 cc. of a saturated solution of ammonium fluoride. Evaporate to dryness on a steam bath and repeat the operation. Heat to dull redness, allow to cool and add a few drops of sulphuric acid. Heat, first on a hot plate and finally over a small flame. Add water and transfer to a beaker. Add 2 grams of pure, powdered barium hydrate, allow the precipitate to settle and filter. Gas the filtrate with carbon dioxide, heat to boiling and filter. Evaporate the solution, add a few drops of ammonium carbonate and filter. Acidify with sulphuric acid (1:2), evaporate to dryness in a porcelain dish, and heat over a flame to drive off the ammonium salts and sulphur trioxide. Add hot water and transfer to a tared platinum dish. Evaporate to dryness, heat over a flame and weigh as combined sulphates of sodium and potassium. If desired, they may be separated and estimated in the usual way.

[1]Ver et Verrerie, 1894, p. 65.

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility THE GLASS INDUSTRY is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions are invited to submit them.

Answers to all questions will be made by mail as promptly as possible. The sources of all inquiries will be held in strict confidence.

Question 23—Etching of Glass.—Please send me full information regarding etching of glass.

Answer.—Etching of glass is done with hydrofluoric acid which is used either as a gas or as a solution of the acid in water. The corrosive action of hydrofluoric acid is due to the ease with which it decomposes glass. The glass is covered with a protective coating consisting of wax or asphalt. The design to be etched is scratched through the coating. The glass is then exposed to the gas or the liquid which attacks the unprotected places. When the wax is removed, a permanent etching like the design is left.

Gaseous hydrofluoric acid renders the etched surface dull white, due to the formation of minute crystals of fluorides of calcium or lead, which reflect the light rays in every direction.

A solution of the acid in water yields a clear and perfectly transparent surface.

Conditions which affect the etching process are:

1—The composition of the glass.
2—The concentration of the acid.
3—The time of exposure.
4—The temperature.

The depth of the etching is proportionate to the concentration, the time and the temperature. Hydrofluoric acid is very dangerous to health. When breathed it causes inflammation of the lungs. The solution causes painful wounds which are slow to heal. For this reason the acid itself is not used as much as formerly, and in its stead acid salts of hydrofluoric acid are employed; namely, sodium, potassium and ammonium hydrogen fluoride. To the solution of one of these salts is added hydrochloric, sulphuric or acetic acid. This causes the formation of hydrofluoric acid from its salt. In order to accelerate the action, neutral salts such as potassium or ammonium sulphate are added which, however, take no part in the etching process.

The following recipes are recommended.

I

Acid potassium fluoride	250	parts
Hydrochloric acid	250	"
Potassium sulphate	140	"
Water	1,000	"

II

Acid sodium fluoride	40	parts
Glacial acetic acid	50	"
Water	1,000	"

III

Ammonium fluoride	1,000	parts
Ammonium sulphate	100	"
Sulphuric acid	200	"
Water	1,000	"

A recipe for wax coating was given in THE GLASS INDUSTRY, Vol. 2, No. 1 (January), 1921, page 6.—J. B. K.

Question 24—Relative Cost of Using Lime and Limestone.—I was interested in your article on the comparative cost of soda ash and salt cake, appearing in a recent number of THE GLASS INDUSTRY. We are seeking some comparisons on the cost of glass manufacture with the use of lime and with the use of limestone, but have been unable to obtain any definite data on the fuel requirements when limestone is used and when burnt lime is used. There have been expressions of opinion that much less fuel is required with burnt lime than with limestone but it seems that no one has thoroughly investigated this subject.

Answer.—It is a well known fact that less fuel is needed to make glass with burnt lime than with limestone; the observation has been made by all those who have used both and have carefully watched results. To our knowledge no definite experimental proof exists, other than general observation.

Investigations in glass technology have not as yet progressed to the point where scientifically planned experiments are carried out which duplicate actual manufacturing conditions. This is

due partly to the fact that until recently little study has been made of problems of glass technology, as compared with the other industries. It is due also to the great difficulties connected with experimentation at the high temperatures which prevail and with large quantities of molten glass.

However, the experience gained in practice can be explained from theoretical considerations. The following is a calculation of the heat requirements of plate glass when made with burnt lime, and when made with limestone. If it is assumed that both are made under exactly the same conditions, the heat losses due to radiation, etc., are similar and need not be considered.

COMPOSITION OF GLASS

Na_2O	14.83%
CaO	13.40%
SiO_2	71.77%
	100.00%

Corresponding to the formula $Na_2OCaO5SiO_2$

CALORIES REQUIRED FOR REACTION

A. Using burnt lime

Kilogram Molecules

106 Na_2CO_3
100 $CaCO_3$
300 SiO_2

462 kg. batch = 418 kg. glass

B. Using limestone

Kilogram Molecules

106 Na_2CO_3
56 CaO
300 SiO_2

506 kg. batch = 418 kg. glass

I. HEATING BATCH TO 1500° CENTIGRADE

Na_2CO_3	$106 \times 1500 \times 0.28 =$	44520 Calories	Na_2CO_3		44520 Calories
CaO	$56 \times 1500 \times 0.17 =$	14280 "	$CaCO_3$	$100 \times 1500 \times 0.21 =$	31500 "
SiO_2	$300 \times 1500 \times 0.20 =$	90000 "	SiO_2		90000 "
		148800 Calories			166020 Calories

II. DECOMPOSITION OF CARBONATES

Na_2CO_3	$106 \times 713 =$	75578 Calories	Na_2CO_3		75578 Calories
CaO		none	$CaCO_3$	$100 \times 451.5 =$	45150 "
		75578 Calories			120728 Calories

III. HEAT OF FUSION

$418 \times 30 =$	12540 Calories	$418 \times 30 =$	12540 Calories
Total I, II and III	236918 "	Total I, II and III	299288 "

HEAT FORMED BY REACTION

1 kg. mol. Na_2SiO_3	65000 Calories	1 kg. mol. Na_2SiO_3	65000 Calories
1 kg. mol. $CaSiO_3$	35000 "	1 kg. mol. $CaSiO_3$	35000 "
	100.000 Calories		100.000 Calories
Total heat required	136918 Calories	Total heat required	199288 Calories
1 kg. glass $\frac{136918}{418}$	= 327.5 "	1 kg. glass $\frac{199288}{418}$	= 476.7 "

In the terms of Coal @ 7500 Calories per kg.

1000 kg. glass: $\frac{327500}{7500}$ = 43.6 kg. coal

1000 kg. glass: $\frac{476700}{418}$ = 63.6 kg. coal

Percentage in favor of burnt line = 46%

The statement that glass made with burnt lime requires 46% less fuel than when made with limestone is of course misleading. Only about 10% of the heat necessary to make glass is expended on the chemical reaction. Fully 90% is needed to heat the glass furnace, is lost through radiation, is carried away with the waste gases and so forth. This cuts down the percentage in favor of burnt lime to only a little over 4%. Undoubtedly the glass maker saves some fuel. It may be asked: Is this saving in fuel not offset by losses and disadvantages which go with the use of burnt lime? Is not the saving on the fuel bill more than balanced by greater charges for raw material? In order to answer these questions the advantages and disadvantages of burnt lime and limestone are set forth in comparison as follows:

ADVANTAGES OF BURNT LIME

1. It is in finely divided condition.
2. It requires less fuel than limestone.
3. It is pure, if made from pure limestone.

DISADVANTAGES OF BURNT LIME

1. It takes up moisture and carbon dioxide in transit and storage and is therefore of uncertain composition.
2. It does not cause any evolution of gas. The melting and fining processes are thereby retarded.
3. It cannot successfully be used in making glass from salt cake.
4. It costs more than limestone.

ADVANTAGE OF LIMESTONE

1. It can be obtained in finely divided condition (Buckwheat size is appropriate for structural glass, crushed chalk and marble for lime flint and semi-crystal glasses).
2. Its composition is stable.
3. Decomposition causes evolution of gas which aids the melting and fining processes.
4. It can be obtained in all grades of purity. Some marbles are almost chemically pure $CaCO_3$, and are used for optical glass.
5. Organic matter helps to make the glass homogeneous. (It is sometimes added to obtain this effect).
6. It costs less than burnt lime.

DISADVANTAGE OF LIMESTONE

It requires about 4% more fuel than burnt lime.

Bohemian glass makers use burnt lime a great deal, or rather they use hydrated lime, as they allow the lime to lie exposed to the air. Hydrated lime is preferred because of the effect due to the expulsion of water. The same result, however, can be had by using limestone, and at a lower cost. The practice of using air-slaked lime cannot be defended on any reasonable grounds and is being abandoned by progressive firms.

Greater purity of burnt lime is sometimes mentioned as an advantage. The reputation of burnt lime in this respect is based on the color as compared with that of limestone, containing organic matter. It is obvious that burnt lime is not purer than the limestone from which it is made. It often contains additional impurities derived from the fuel needed for burning. A preference based on such a ground needs no further comment.

From an economic standpoint it is of course a waste to use burnt lime, since the amount of fuel needed in its manufacture is far greater than the saving of fuel to the glass maker. This finds an expression in the higher cost of burnt lime. Knowing the cost of burnt lime and of limestone it is possible to compute the difference in cost to the glass maker.

We should be pleased to have you advise us of any arguments in favor of burnt lime, other than the saving of fuel.—J. B. K.

Letters to the Editor

American Machinery Manufacturers Need Better Understanding of English Factory Conditions

R. L. Frink, Director of Research, British Glass Research Association, in a Letter to THE GLASS INDUSTRY, Points the Way to More Complete Success in the Introduction Into Europe of American Glass-Working Machinery.

To the Editor of THE GLASS INDUSTRY:

First I wish to say that I am greatly interested in the many valuable and interesting articles which you are publishing and I wish to express my appreciation of the masterly way in which THE GLASS INDUSTRY is handling its editorial matter. I am quite sure that you are supplying the deficiency which the industry so long endured by putting before managers, superintendents and technologists in a very unbiased, clean and concise way, the scientific and technical facts as they develop from day to day in the up-to-the-minute method which you pursue in keeping abreast with the times. It is because of my thorough appreciation of your paper that I take the initiative in presenting to you that which possibly, and evidently, has not occurred to the minds of a good many of the suppliers of glasshouse equipment.

I have had an unusual opportunity of studying the conditions as they exist in England and the difficulties incident to the installing of mechanical glass forming apparatus and obtaining the required production or efficiency from such apparatus which will make the purchaser and user satisfied with his investment. Because of the knowledge gained by this study I feel that I would not be doing my duty to the members of the British Glass Research Association, nor to my many friends in the United States who are the inventors, makers and suppliers of glass making equipment, if I did not urge upon them to recognize a few of the most serious and important factors which they should take into consideration.

Over here one not infrequently hears the complaint from purchasers of American machinery that they went over to America, saw certain apparatus operating with the highest degree of efficiency and turning out unheard of production. As a result of these observations, this or like equipment was purchased, brought over to England and so far as their knowledge went, put into operation under identically the same or similar conditions, but in a great many instances the results have been highly disappointing. Reason for these disappointments may usually be found in the fact that the purchaser bought the machines with all the necessary drawings and information, so far as they can be put upon paper, and then brought the equipment over here and made their installations as best they were able. The American supplier having got his money, promptly turned it to the financing of further energies and considering that he had no further responsibility, forgot all about his English customer until, in some instances, he received information that the apparatus was not fulfilling expectations and then a long series of correspondence followed resulting in no immediate benefit to the customer but probably in more or less aggravation of mind and discontent on the part of the supplier and purchaser.

In a few very rare cases was the supplier specifically called upon, or at least he did not initiate, any definite efforts towards alleviating the situation of his English customer by sending to him one, or if necessary more, skilled men to straighten out the situation and make a reputation for his equipment and himself in England equal to or approaching that with which he is favored in the States and which is usually described as "We deliver the goods."

I do not wish to imply that any American supplier intentionally wishes to, or even dreams of shirking his responsibilities or neglecting his obligations and business interests for I am well convinced that the majority of them do not understand the situation in England and the requirements, the fulfilling of which is so essential to produce perfect and complete success with any type of apparatus that they wish to market.

I am quite aware that a number of inventors, manufacturers and suppliers over there have spent a great deal of time and money in sending their mechanics over here to set up and operate their machines and this has been attended with varying degrees of success. In all these instances the men sent have been men who have been on the job, that is mechanics or those who are competent to assemble and start the machines. They had little or no knowledge of factory organization, or at least if they had, did not feel that it was incumbent upon them to enter into the organization of the factory, or to take into consideration that such organization must of necessity become co-ordinated with the new methods of doing things required by the introduction of the machines and they usually stayed on the job, or went away feeling that it would be stepping outside their duties and possibly would be interfering with that with which they were not concerned if they attempted to offer any suggestions regarding the re-organization of the factory.

In some cases I believe that this was a wise procedure for it is a fair assumption that the mechanical engineer on a job has little or no conception of what is required with regard to factory organization.

The necessity for factory re-organization, however, remains and I think that it can be set down as an established fact that over fifty per cent of the difficulties which are encountered by users of mechanical equipment can be attributed to the absence of proper organization and plant and men to meet the conditions which the machines require and impose.

I know of numerous instances where machines have been installed which we in America would consider as being of the most efficient type for the production of the particular classes of ware for which they were designed and which have been installed under what were considered to be very favorable conditions, operated with more or less mediocre success for a short period of time and then because of their failure to produce even approximately that which was expected have been set aside and are now standing idle and rusty. Yet at the same time the American vendors of some of these machines wonder why it is that they are meeting with difficulties when they go over to the Continent and attempt to sell their patent rights or license their machines and fail to get them installed upon any kind of terms.

They seem to forget that the metropolises of these countries are nearer to the centre of England from a geographical standpoint than Columbus is to Pittsburgh and that intercourse between the manufacturers in these countries is not a matter of days or weeks but of minutes or hours. For example, one can leave one's house at 8:30 in the morning, be in Paris before noon, do business and take dinner at home about 7:30 o'clock the same evening.

I had an American representative say to me only a few days ago that he could not understand why it was that the Continental people seemed to be so terribly touchy, sceptical and lacking in confidence of the results of his equipment, for it had been seen in successful operation in the States. When I asked him if it was equally successful in England he replied that it might be as successful if the people who had the machine would inaugurate the proper operating conditions. He seemed very much surprised when I intimated that there was no one more to blame than he was, for such conditions existing. If he would stop to consider he would realize that the English glass manufacturer had been going along for generations back with an old and established trade behind him with a feeling of absolute security of his position as it had existed in the past and that he had done all and everything which he had been told to do to make the machines operate, but had found that these machines would not operate to

his satisfaction. Such a manufacturer without further advice would assume that it was not worth while to jeopardize his future by continuing with an expensive plaything and quite naturally he would no more recognize the fact that it was organization which was responsible for his failure than this individual American respresentative recognized that his failure to place contracts on the Continent was in no small measure due to the intimate and constant intercourse between the Continent and England and his failure to recognize the true situation here.

Another source of trouble lies in the lack of co-operation between the sellers of machines and the sellers of accessory equipment, *e. g.*, those selling feeders and forming machines. In order that the greatest efficiency may be obtained there should be the closest co-operation between the organizations concerned.

I believe that if you wish to be of material assistance to our American friends and simultaneously of invaluable help to our English cousins you will unhesitatingly and energetically endeavor to inject a germ of rapid inquisitiveness into these conditions which are not understood by American suppliers of machines and which they feel are no fault of theirs.

I candidly believe that unless someone can get the American suppliers to understand the true situation and the problem which confronts them in England they are making a great mistake in attempting to introduce any equipment in England, for any failure which occurs does not stop within the bounds of the British Isles, but travels far and wide.

I deeply deplore this sort of situation for I have great pride in American ingenuity, efficiency and efficacy of their production, but I must confess that this pride is not receiving the encouragement which I should like it to enjoy, because of what now seems to me like a most abnormal and unusual lack of sagacity on the part of our inventors, manufacturers and suppliers of equipment.

R. L. FRINK,
Director of Research.

Glass Research Association, London, W. C. 1, England.
24th February, 1922.

Tar in Producer Gas Burners

To the Editor of THE GLASS INDUSTRY:

With reference to the question [No. 22, page 59, March issue] regarding the gasification of wood in producers and the trouble one of your readers located in South America is having with tar and ashes in his gas conduits, I would suggest that the trouble may be due to carrying over a large amount of wood ash from the rather light fuel bed in the producer due to the action of the blast. This trouble could probably be greatly reduced by inserting some sort of dust collector, which would simply be a large chamber located as near the producer off-take as possible, thus reducing the gas velocity and allowing the comparatively heavy ash particles to settle out. The trouble he is experiencing with tar in the conduits may be due to the fact that the gas is allowed to cool sufficiently in its passage from producer to furnace to cause condensation of the tar vapors. If this is the case the best way to overcome this trouble is to line the conduit with some insulating material such as sil-o-cel brick or cork insulating brick. These conditions as given in your letter would seem to be common to almost any producer gas system and not particular only to producers gasifying wood.

In case it would be possible for you to get from this party some sort of a simple sketch of his producer arrangement showing how the producers are connected to the conduits and the construction of the conduits showing the method of lining same and the material used for lining, or in case no lining is used to state this specifically, it might be possible to remedy this trouble he is having.

With this information it would be a simple matter to determine whether his layout is correctly made or if not how it can be made to give satisfactory retults with the least cost to him.

R. F. CLEWELL.

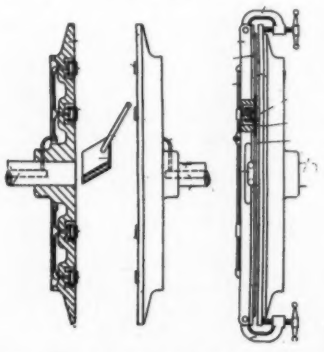
Corning, N. Y.,
March 4, 1922.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of the Patent Specifications mentioned below may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c. each.

Grinding or Polishing of Glass and Apparatus Therefor.—U. S. 1,404,553. Jan. 24, 1922. Frank Edwin Slocombe, of St. Helens, England, assignor to Pilkington Brothers, Limited, of St. Helens, England.



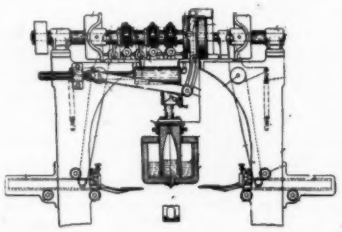
According to this invention the supports for the glass plates and for the abrasive carrying surfaces are two discs with vertical surfaces, the glass being attached to the surface of one or both of the discs by means of suckers.

The two discs are mounted face to face on two parallel (or nearly parallel) shafts. One disc is provided with means for rotation, while the other disc is either free to rotate or is also provided with means for rotation, either in the same direction as the first disc or in the opposite direction. One or each of the discs is capable of being moved away from the other while running, in the direction of its axis, and is capable of being shifted edgewise in a direction at right angles to its axis.

One disc may serve as a table for holding glass while the other serves as a grinding or polishing surface, or both discs may have glass attached, each serving as a grinding surface for the other.

Apparatus for Feeding Molten Glass.—U. S. 1,405,936. Feb. 7, 1922. Karl E. Peiler, of West Hartford, Connecticut, assignor to Hartford-Fairmont Company, of Canajoharie, New York.

The object of this invention is to provide an apparatus which will form and deliver a series of uniform mold charges of various sizes and shapes, to suit the particular ware being manufactured. In this invention the impulses acting to form and shape the gather are produced by variation in the air pressure which controls the rate of discharge of the glass, and therefore means is provided for varying the air pressure from a condition approaching a vacuum to normal atmospheric pressure and to a condition of compression higher than atmospheric pressure. Means is also provided to permit independent adjustment of the duration of the various air pressures. By a proper adjustment of the time and amount of these pressures, mold charges of any desired shape and size may be produced, and slight adjustments may be made to counteract otherwise uncontrollable changes in conditions involved, and uniformity in the desired shape and size of the charges may be maintained.



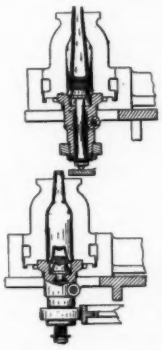
Method of and Apparatus for Finishing Bulbs.—U. S. 1,404,268. Jan. 24, 1922. William R. Burrows, of Newark, New Jersey, assignor to General Electric Company.

The object of this invention is to reduce the breakage of bulbs and similar articles of glassware, to produce bulbs more free from strain than the ordinary bulbs, and with necks of

the proper length and a well finished edge, to provide an improved method of and apparatus for removing the waste glass from the neck of bulbs and similar articles, to eliminate the cracking off operation in the lamp factory, to cheapen and improve the manufacture of incandescent lamp bulbs and similar articles of glassware.

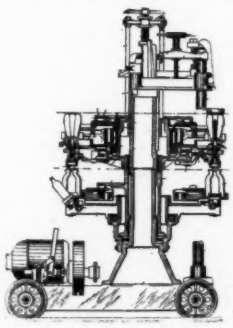
The bulb, still very hot, is carried to a position where the neck, still plastic, is flared or reamed out, if necessary, until the bore is of the proper size and the plastic edge is smooth. The glass working operations on the bulb are now completed, and for the first time the bulb is permitted to cool down to the critical temperature where strains may develop in it.

Means for Making Bottles.—U. S. 1,404,206. Jan. 24, 1922. Richard La France, of Toledo, Ohio, assignor to the Owens Bottle Company, of Toledo, Ohio.



This invention relates to new and useful improvements in means for making bottles and is adapted for use with an automatic bottle blowing machine of the type disclosed in the co-pending application of Joseph B. Graham, Serial No. 201,644, filed Nov. 12, 1917. With the present invention, the bottom of the bottle is partially formed in the parison mold by an end plate having a central projection surrounded by an annular space. The plastic glass is forced into this space, thereby forming an annular extension on the bottom end of the blank. The bottom piece for the finishing mold comprises a central section or plunger which, while the bottle is being blown, is projected upwardly within the body of the finishing mold so as to enter the cavity formed in the bottom end of the parison. After the bottle is blown in the finishing mold said bottom is withdrawn to permit the bottle to drop when the mold bottom is tilted.

Machine for Making Hollow Glassware.—U. S. 1,405,204. Jan. 31, 1922. Joseph B. Graham, of Evansville, Ind., assignor to the Owens Bottle Company, of Toledo, Ohio.



In its preferred form, the machine comprises a mold carriage rotatable step by step about a vertical axis. The blank molds which are arranged in a circle on the carriage with their upper ends open to receive the charges of molten glass, are thus brought successively into charging position. Beneath the blank molds and in register therewith are neck molds in which the necks of the bottles or other articles are formed. The neck mold and body blank mold together form a parison mold in which the glass is blown to partly form the article. The body blank mold is then opened, leaving the parison supported by and projecting upwardly from the neck mold. The latter is then rotated to swing the parison outwardly and downwardly into an open finishing mold, which is then closed around the parison, after which the parison is blown to the form of the finished article.

Glass and Method of Making Same.—U. S. 1,403,752. Jan. 17, 1922. Erik W. Enequist, of Brooklyn, New York.

An object of the invention is to provide an improved method of making glass and allied vitreous substances, black soda glass, or various forms of colored, or slightly colored glass, wherein the principal alkali is soda.

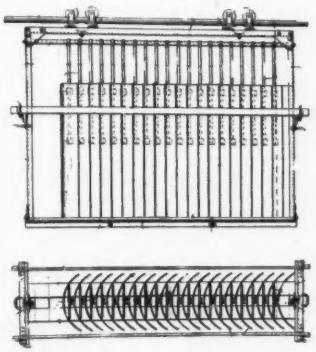
Another object is to utilize slags, such as basic soda slag, resulting ordinarily as waste in certain blast furnace, smelting, or metallurgical operations.

In certain furnace operations, sodium sulphates or bi-sulphates, are used in connection with a reducing agent, such as coke, coal, etc., with or without an addition of common salt (sodium chloride), with the result that, a sodium sulphide is formed which in turn gives off part of its sulphur to the various metals present, forming metallic matte, or sulphide; and the soda combines with the silica contained in the ore, or by the addition of sand, thus forming a basic soda slag which is drawn off from time to time in a liquid form. This slag contains a large proportion of basic sodium silicate, as for example, about 20-40% of soda, Na_2O, combines with 30% to 50% of silica during the furnace operation.

The slag thus obtained contains most of the iron present in the ores as an impurity, such as ferrous silicate. Besides iron, the slag contains a varying percentage of alumina, derived usually from the furnace lining. The slag also contains other impurities found in the original ores, as for instance in silver, copper, nickel and cobalt ores, or impurities contained as ingredients of the furnace lining or of the bricks used to hold the charges.

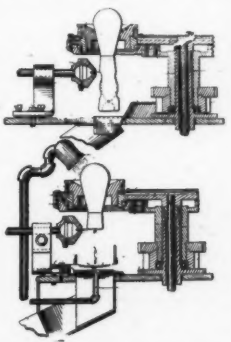
This basic soda slag has the property of further combining with its own weight, or greater weight of sand or silica and other glass-making materials, thus forming a workable glass after being properly manipulated as is customary in the glass-making industry. The glass thus produced is jet black in appearance and effect, as the ferrous iron in combination with minutely distributed carbon imparts an intense dusky green color to the glass, which in effect is black.

Carrier for Glass Articles.—U. S., 1,405,757. Feb. 7, 1922. Henry F. Clark, of Oakmont, Pennsylvania, assignor to Window Glass Machine Company, of Pittsburgh, Pa.



This invention relates to carriers for glass articles. In the manufacture of window glass and the like, the glass is drawn or blown into hollow cylinders. In the larger sizes of these cylinders, it is customary, before flattening them, to split them into two or more segments. These segments are commonly known as "shawls." The object of my invention is to provide a carrier of simple and convenient character and construction by means of which a plurality of shawls may be moved from place to place without breakage, as in moving them from the splitting room to the flattening ovens.

Method of and Apparatus for Finishing Blown-Glass Articles.—U. S. 1,409,847. March 14, 1922. David E. Gray, of Corning, N. Y., assignor to Corning Glass Works, of Corning, N. Y.



This invention relates to certain improvements in method of and apparatus for finishing blown glass articles, having comparatively thin walls, of which walls it is desired to remove certain excess portions. Electric lamp bulbs in the shape that they are blown are taken as the particular example of the articles to be treated, and the invention has for its object to provide for the rapid and economical removal of moil from the neck of such a bulb preparatory to subsequent treatment of the bulb. It contemplates a turret mechanism adapted to hold a bulb and position it at several successive stations, means for driving the turret from station to station, the bulb being rotated within the turret, means for heating at the several stations a narrow zone of the neck of the bulb above the moil, whereby the moil will be drawn off of the neck and means whereby the film formed across the neck by such drawing off of the moil will be upturned and melted.

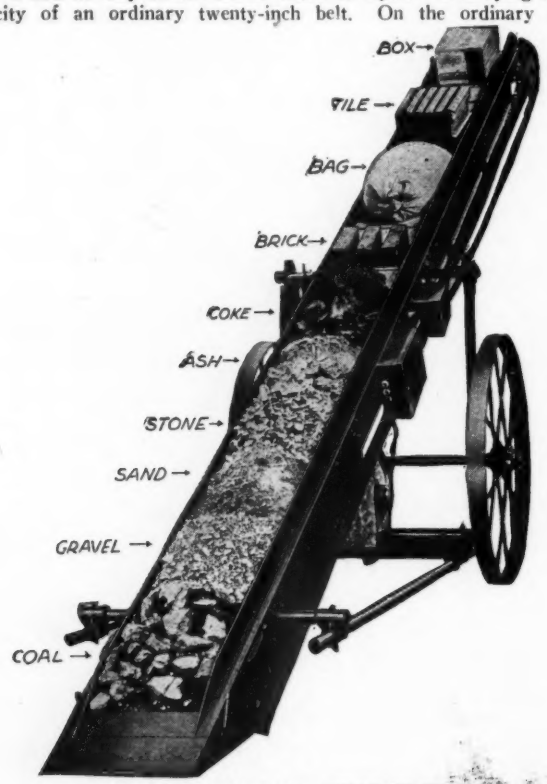
Glass Factory Equipment and Supplies

THE GLASS INDUSTRY will be glad to publish descriptions of new and useful devices, machinery and supplies of interest to the glass manufacturing trade. Most of the information printed in this department comes direct from the manufacturers of the products described.

The Scoop Conveyor

The distinctive feature of the portable machine here illustrated and the one which gives it the nature of scoop conveyor, is the scoop on the feeding end. This scoop can be pushed into the material to be conveyed, even to the point of actually burying it therein, if necessary. This makes it possible simply to scrape the material to be carried on to the belt, instead of lifting it by shovelfuls or barrowfuls into the feeding hopper. This feature, combined with the portable conveyor idea, which is not in itself any longer a novelty, insures that however short be the distance through which material has to be transferred from one conveyor to another, from resting place to conveyor, etc., there will be a machine to do it, and the man with the wheelbarrow and the hand scoop will not have to waste his time and his employer's money doing the work by primitive methods.

Another feature of the conveyors illustrated lies in the structure of the conveyor sides, or skirt plates, as they are called. These form a trough which, the manufacturer states, makes it possible for a belt of only twelve inches width to equal the carrying capacity of an ordinary twenty-inch belt. On the ordinary or



THE SCOOP CONVEYOR AND WHAT IT HANDLES.

troughed belt, the material is carried in the main in the trough at the center, that on the sides falling or rolling back into the trough. The side plates give the entire width of the belt the same carrying effectiveness as the center.

The carrying capacity of the twelve-inch scoop conveyor, based on handling coal, is one ton per minute, provided the supply of material at the receiving end of the machine can be kept up to this rate. If the storage pile is of sufficient height, one man can easily approach this maximum to the extent of feeding one ton in a minute and a half, otherwise he may require from two to four minutes. Where speed is the prime consideration it can be attained by assigning two men to the work of loading the conveyor. In delivering loads from hopper-bottom cars to trucks, there is no question of the supply of material at the feeding end of the conveyor, and the extreme speed of one ton per minute can be maintained without difficulty with one man to attend to the loading end of the apparatus.

Perhaps it will not be superfluous to point out explicitly that the leading role of the scoop conveyor is in the storing, reclaiming and loading of bulk materials and light articles. Its makers claim that it is the machine par excellence for transferring and trans-shipment. Practically anything can be handled by it—coal of all varieties, ashes, sand, crushed limestone, salt cake, slag, chemicals, light packages, etc. It may be used singly, in tandem or in triplicate as required. There is hardly any limit to the height to which storage piles may be raised, if the material is brought to them and taken from them in this fashion.

Scoop conveyors are made in 14, 20 and 25-foot lengths, each length being obtainable in 17 or 21-inch widths. They are manufactured by the Portable Machinery Company, Paterson, N. J.

Successful Test of Lynch Model "B"

Lynch Glass Machinery Company, Anderson, Ind., announce that thirty-two one-half oz. prescription bottles per minute are being produced with ease on their new model "B" automatic forming machine worked in conjunction with a mechanical feeding device at the plant of Turner Brothers Company, Terre Haute, Ind.

They state that no preliminary experimental work was necessary. The machine was designed and built in their factory and when installed was started on one-half oz. prescription bottles and promptly went to work at a speed of 32 bottles per minute and continues to perform at this speed without the least distress.

A range of ware from one-half oz. to four oz. sizes in the narrow neck bracket may be made and the same sizes of wide mouth where the outside diameter of mouth is not too large may also be mounted on this machine.

The machine may be seen in operation by appointment with Turner Brothers Company at their Terra Haute factory.

Tirrill Gas in Glass Factories

The Tirrill Gas Machine Lighting Company, 50 Church street, New York, announce the receipt of a second repeat order for a Tirrill Gas Machine installation at the plant of the Hart Glass Company, Dunkirk, Ind. The Tirrill machine makes gas automatically from gasoline, and provides a safe and reliable supply of good gas for lighting purposes, for use in the cracking-off and glazing department, for heating and cooking, and for all sorts of special and auxiliary purposes in the glass factory where clean gas is required. The Tirrill company makes a strong point of the fact that the owner of a Tirrill plant need not worry over coal strikes nor shortage of natural gas in cold weather.

Suggests Refractories Committee of Thirteen.—At the annual meeting of the Refractories Manufacturers' Association held in Chicago recently, the president, J. F. Ramsay, urged the formation of a committee of thirteen to make a thorough industrial survey of operations in which refractories are utilized, to ascertain actual service conditions in the following fields: 1. Blast furnaces, not blast stoves. 2. Open-hearth furnaces, soaking pits. 3. Heating, puddling and forging furnaces. 4. All types of boilers. 5. Cement, lime and plaster kilns. 6. Window, plate, bottle and optical glass. 7. Annealing, malleableizing and air furnaces. 8. Water- and coal-gas generators, gas producers. 9. Cupolas and gray iron furnaces. 10. Oil refineries. 11. Zinc, lead and copper smelters. 12. All types of by-product coke ovens. 13. All types of ceramic kilns.

United States Glass Trade in January

Exports of glassware in January, 1922, fell 17 per cent. short of the December aggregate, and imports of glass by 4 per cent. The falling off in glassware imports is but a continuation of the drop in values that has been in progress since October.

IMPORTS.

Glass and glassware	January, 1921 Quantity	January, 1921 Value	January, 1922 Quantity	January, 1922 Value
Bottle, vials, carboys, etc., plain, empty or filled, lbs.	372,615	$18,957	438,484	$13,805
Bottles, decanters, and other glassware, cut or ornamented	.....	113,245	.....	132,575
Optical instruments, including lenses and spectacles	.....	88,723	.....	72,307
Sheet and plate glass:				
Cylinder, crown and common window glass, unpolished lbs.	1,168,632	86,865	2,609,304	126,254
Plate glass, cast, polished, unsilvered, sq. ft.	335,774	283,848	454,051	232,853
Plates or disks, rough-cut, for optical purposes, lbs.	95,837	91,063	9,382	9,515
All other	.....	190,306	.....	176,583
Total imports of glass and glassware	.....	873,007	.....	763,892

The new statistical classification of glassware exports went into effect at the beginning of the present calendar year. Detailed comparison with earlier periods is made somewhat difficult by the change, and in a study of the export figures below it must be borne in mind that the blanks under 1921 do not mean that there were no shipments, but merely that these articles were not separately listed last year.

EXPORTS

Glass and glassware	January, 1921 Quantity	January, 1921 Value	January, 1922 Quantity	January, 1922 Value
Plate and window glass:				
Window glass, common boxes *a*	28,231	$228,563	1,466	$9,405
Plate glass, unsilvered, sq. ft.	442,925	316,325	282,744	109,007
Wire glass, sq. ft.	.....	.....	22,844	3,105
Other window and plate glass, n. e. s., lbs.	.....	.....	127,384	11,241
Glass containers (bottles, vials, and jars), lbs.	.....	999,002	2,164,432	134,729
Table glassware, plain, lbs.	.....	.....	321,024	55,081
Table and other glassware, cut or engraved, lbs.	.....	37,843	10,011	5,444
Glassware for lighting:				
Lamp chimneys and lantern globes, lbs.	.....	.....	99,144	21,211
Globes and shades for lighting fixtures, lbs.	.....	.....	95,895	35,272
Lamps and other illuminating devices, chiefly of glass, lbs.	.....	.....	111,202	53,246
Chemical glassware, lbs.	.....	41,528	15,675	7,609
Electrical glassware, except for lighting, lbs.	.....	.....	81,627	13,074
Other glassware, n. e. s., lbs.	.....	1,551,308	1,120,916	270,030
Total exports of glass and glassware	.....	3,174,569	.....	728,454

a Boxes of 50 square feet.

The decline in exports of common window glass to only 4 per cent. of the 1921 value is the result of an almost complete cessation of shipments to the hitherto important markets of Canada, Cuba, Argentina, Brazil, Uruguay, China, and Australia. Mexico accounted for nearly half of the January, 1922, exports under this head, but took only 11 per cent. as much as in January of last year.

Total imports of glass products for the seven months ending January 31, 1922, were $5,817,807, compared with $7,006,955 for the corresponding period of a year ago. Total exports for the seven months, July 1, 1921, to January 31, 1922, were $5,141,956, against $18,538,516 for corresponding period ending January 31, 1921.

Harbison-Walker Annual Statement

The 19th annual statement to stockholders of Harbison-Walker Refractories Company, Pittsburgh, Pa., for the year ended December 31, 1921, shows net profits after charges, depreciation and Federal taxes of $1,751,444. After deduction of preferred dividends to the amount of $196,493, and dividends of $1,494,411 on common stock there remained $60 539 surplus profit for the year. This made the earnings applicable to the common stock $5.75 a share.

This compares with net profits of $2,869,996 or $8.79 a share on the $27,000,000 common stock in 1920 after preferred dividends.

The balance sheet as of December 31 last, showed a shrinkage in the item of cash on hand to $1,403,696 compared with $2,304,657 a year ago; securities $8,833,888 against $8,459,148; accounts and bills receivable $1,569,584 against $3,519,639 and inventories $1,873,486 against $1,654,109. Accounts payable totaled $294,714 against $888,220 on December 31, 1920, reserves $3,594,006 against $4,957,885 and surplus $4,943,457 against $4,882,918.

In transmitting the statement to the stockholders, H. W. Croft, chairman, said:

"Our earnings for the year are relatively the lowest in the history of the company, due to re-adjustment of wages, selling prices and inventories, but all things considered, we feel are fairly satisfactory. Wages were at the highest peak the first of the year. Since then three adjustments have been made, amounting to a reduction of thirty-three and one-third per cent, the present wage scale being seventy per cent higher than pre-war basis. Sales for the first month of the year amounted to thirty per cent of our total capacity and steadily declined to the lowest point in April, amounting to fifteen per cent of capacity. From April until the end of the year there was a gradual increase in orders, closing with forty per cent of capacity for December. The average selling price of our products has steadily declined to the extent of forty per cent of the average selling price at the first of the year. Operations during the first quarter, due to contracts carried over from previous year, were at double the rate of new business received during that period. Inventories have been thoroughly liquidated, and in this respect our company is in a strong position.

"As to general conditions and future prospects of the refractories industry, our own survey of the situation after conferring with our best informed customers leads us to the belief that we can look for a continuance of business at about the same rate as in December, and while we hope to see a gradual increase in this rate, there is at present nothing in sight that would warrant any expectation for the return of normal business during the present year."

The stockholders' meeting will be held April 17, 1922.

Harbison-Walker Refractories Company, through R. E. Hilleman, secretary, states that recent reports in the press to the effect that the capital stock of the company had been reduced from $36,600,000 to $30,000,000 are incorrect. A resolution was unanimously adopted at a directors' meeting on February 24, 1922, in favor of making such a reduction by retiring $6,600,000 of preferred stock now in the company's treasury and a special meeting of stockholders has been called for May 15 to take action on the proposed decrease.

United States Glass Company Report

The results from operation for the year of the United States Glass Company, Pittsburgh, Pa., show a net loss after all charges except inventory loss and depreciation, including charges of $109,586 for extraordinary repairs, replacements, etc., of $5,321. There was a further net loss in the Glassport Land Company of $12,174. Inventory values were reduced to the extent of $383,460, making the total deficit for the year $400,955. Dividends amounting to $128,000 were paid.

The report states that notes and accounts receivable are valued at $531,737 after deducting $25,000 for probable shrinkage due to uncollectible items. Inventory values on December 31, last, were fixed at $1,014,685, compared with $1,418,215 on the corresponding date of the previous year. The balance sheet as of December 31, last, shows:

Assets—Current $531,737; inventories $1,014,685; unpledged securities $46,194; other convertible assets $30,650; investments $763,652; buildings, equipment, etc, $2,445,742; deferred charges $30,269; total $5,123,060.

Liabilities—Capital stock $3,200,000; funded debt $390,000; current liabilities $669,985; reserves $245,523, surplus $617,772; total $5,123,060.

No Summer Stop This Year.—At the annual gathering of the National Association of Window Glass Manufacturers of Pressed and Blown Glassware at Pittsburgh in March it was agreed between the members and representatives of the Flint Glass Workers that there would be no summer stop this year. The annual election of officers was held and all present officers were re-elected.

British Trade in Glass in 1921.—Imports of glass and glassware declined from £8,506,708 in 1920 to £4,622,111 in 1921. Exports dropped from £3,210,809 in 1920 to £2,176,023 in 1921.

Pittsburgh Plate Glass Report

The Pittsburgh Plate Glass Co. reports net earnings for the year 1921 $6,742,875, after deducting $3,126,656 for depreciation and obsolescence and a reserve for Federal taxes of $1,150,000.

The reserve of $4,850,000 established at the close of 1920 has been reduced $4,041,310, Federal income and excess profits taxes on 1920 earnings paid in 1921 amounted to $5,422,404, which was $77,595 less than the sum estimated and reserved out of 1920 earnings. This difference of $77,595 has been added to surplus account. After the payment of the regular cash dividends, there remained a balance of $3,872,160, which was added to surplus account, increasing that account to $20,159,586. Expenditures for additions to investments amounted to $2,409,694, but after the deduction of depreciation and obsolescence, there was a net decrease of $716,961 in investment accounts. There were no bills payable, current accounts payable were reduced from $3,132,797 to $1,847,064.

The balance sheet as of December 31, last, shows merchandise amounting to $7,525,782; material and working accounts $5,708,017; bills and accounts receivable $12,041,244; cash and cash items $3,752,975 accounts payable $1,847,064; and total assets and liabilities of $64,464,939.

Extra Plate Glass Dividends.—The Pittsburgh Plate Glass Company has declared a special dividend of 5 per cent. on the common stock in addition to the regular quarterly dividend of 2 per cent on the common, both payable April 1, 1922, to stock of record March 15.

Owens Bottle Company Profits

The Owens Bottle Company, Toledo, O., for 1921 reports manufacturing profits of $797,422, against $4,343,490 in 1920. Total profits, including royalties, totaled $1,938,490, against $6,469,104, and net profit after all expenses, including reserves for Federal taxes, amounted to $1,369,096, against $4,222,205 in 1920.

The general balance sheet shows a drop in the profit and loss surplus from $9,720,564 at the close of 1920 to $4,458,638 at the close of last year. Cash on hand at the end of 1921 amounted to $2,421,112, against $1,475,294 at the end of 1920; inventory was valued at $5,450,325, against $7,209,504, and accounts and bills payable $1,238,980, against $2,324,866.

Hoover Calls Conference of Trade Associations

Secretary of Commerce Hoover will hold a conference in Washington with representatives of trade associations the activities of which are national or interstate in their scope, in room 704, Department of Commerce building, on April 12, 1922, at 10 a. m., for the following purposes:

1. Securing a list of trade associations that will furnish voluntarily to the Department of Commerce the classes of statistical information outlined in the correspondence between the Department of Commerce and the Department of Justice, released on February 16, 1922, and printed in March issue of THE GLASS INDUSTRY.
2. Discussing and considering means and methods that may be best adapted for collecting and forwarding to the Secretary of Commerce, for dissemination, the classes of statistical information outlined in the correspondence referred to, including the forms of reports that will be most suitable, for associations that are willing to furnish such statistical information.
3. Discussion of the manner in which such reports of the statistical officer of the associations are to be filed with the Department of Commerce, and the manner and method of distributing the information therein to the members of the associations and to the public.

New Indictment Against Window Glass Men

As a sequel to the dismissal on technical grounds of the indictment returned last November against more than 100 concerns and individuals connected with the window glass industry, a new Federal grand jury indictment was filed on March 18, with Judge Mack in New York, charging, it is reported, that William L. Munro, president of the American Window Glass Company, and thirty officers of various other corporations, together with three labor leaders: Joseph M. Neenan, James T. Zellers and W. A. Andorffer, connived to control prices of window glass by curtailing production.

Instead of the Johnston Brokerage Company being named as principal defendant as in the earlier indictment, that company is made a party defendant in the new charge, and the American Window Glass Company of Pittsburgh is named as the principal offender.

It is believed that former Ambassador John R. Davis will represent most or all of the parties named in the new indictment, as he did those named in the first one, when they make their pleas to the court within a very short time.

Building Boom on the Way

February construction was 73 per cent greater in volume than in February, 1921, according to the F. W. Dodge construction reports. Only one February on record exceeded it. For the first two months of this year a total increase of 60 per cent is shown over January and February last year. From January 1 to February 28, 1922, twice as much contemplated work was reported as was placed under contract, which is a promise of sustained activity. New building work in January, 1922, exceeded the average of all January records since 1913 by 130 per cent.

In some localities high labor costs continue to retard construction. In the Flatbush section of Brooklyn, N. Y., for instance, tile fitters are now being paid $16 a day.

Belgian Plate Glass Manufacturers Unite to Obtain American Orders.—The following Belgian plate glass manufacturers have organized the "Union Commercial des Glaceries Belges," whose agent in the United States is W. A. Michiels, 5 Beekman street, New York. The Union Commercial is entrusted with the sale of the entire output of the affiliated glass works.

Société Anonyme des Glaces Nationales Belges, St. Roch-Auvelais; Société Anonyme des Glaces d'Auvelais, Auvelais; S. A. des Glaces de Moustier s/Sambre, Moustier-sur-Sambre; S. A. des Glaces de Charleroi, Roux; S. A. des Glaces de Sainte-Marie d'Oignies, Aiseau; S. A. "Compagnie de Floreffe," Floreffe.

Personals

ROBERT BIDDLE, of the Biddle-Gaumer Company, Philadelphia, Pa., was elected president of the National Lighting Fixture Manufacturers Association, at the annual convention held recently in Milwaukee, Wis.

DOS TAYLOR, one of the best known and experienced men of the glass industry, has been elected president of the Pittsburgh Clay Pot Company, North Side, Pittsburgh, Pa., an office which was held by Maj. A. H. Heisey until his recent death.

At one of the most impressive gatherings ever held in Corning, N. Y., ALANSON B. HOUGHTON, of the Corning Glass Works, whose appointment to be Ambassador to Germany was recently confirmed by the Senate, was presented by the company's employees with a silk flag and a book in which were written the names of every person now in the service of the company.

R. L. FRINK, the well-known authority on glass and glass engineering, who went to England about two years ago at the request of the Glass Research Association to become director of research for that association, which is the British national organization for the furtherance of scientific and industrial research in glass, arrived in New York on March 23 on the steamship *Homeric*, for a short visit in this country. Mr. Frink expects to leave for England again on April 15.

Deaths

Thomas Jenkins Craven, president of the Salem Glass Works, Salem, N. J., died suddenly on March 18 at Cravenhurst, his residence, from a heart attack. Mr. Craven was born in Philadelphia in 1837. In 1880 he went to Salem and the following year purchased the Salem Glass Works of which he remained president until his death. His widow, one son, Col. D. Stewart Craven, and four daughters survive him.

News of the Trade

THE GLASS INDUSTRY will be glad to receive notices of new glass manufacturing projects, plant extensions, removals, personal items, etc.

THE THREE RIVERS GLASS COMPANY, according to a press report, has been incorporated at San Antonio, Tex., with a capital of $50,000. The company will manufacture glass bottles.

THE PEERLESS CORK COMPANY, 26 Prospect street, Newark, N. J., has been organized to manufacture cork products, seals, etc., Charles A. Hansen, 61 Linden avenue, Irvington, N. J., is interested.

THE UEHLING INSTRUMENT COMPANY, manufacturers of CO_2 recorders and other fuel economy equipment, have moved their office to their factory, 473 Getty Avenue, Paterson, N. J., from their former address, 71 Broadway, New York.

THE ILLINOIS GLASS COMPANY announces that their machinery division, the U. S. Bottlers' Machinery Company, recently purchased a new building at 4015 North Rockwell street, Chicago, Ill., which gives them more commodious factory and storage space.

THE AUSTRALIAN GLASS MANUFACTURERS COMPANY of Brisbane and Adelaide, is reported by United States Consul MacVitty to be erecting near Auckland, Australia, a large new glass factory to be equipped with the latest types of machinery and to be operating within six months.

The LICKING WINDOW GLASS COMPANY'S factory at Utica, O., was totally destroyed by fire on March 4, including the blowing, flattening and cutting departments. H. W. McCann, secretary of the company, states that they expect to rebuild in the near future as soon as readjustments are completed.

At the annual meeting of the stockholders of the UNITED STATES GLASS COMPANY, Pittsburgh, Pa., held on March 15, the following directors were elected: L. Z. Birmingham, James F. Challinor, Marion G. Bryce, Reuben Haley, L. A. Meyran, Ernst Nickel, C. E. Willock, H. N. Trimble, David Yost.

THE SCOTT-WARMAN GLASS COMPANY, Stroudsburg, Pa., who, as mentioned in the March issue, will rebuild their factory recently destroyed by fire, are taking bids for a building twice the size of the old one and expect to let the contract by April 1. They are planning to put in an additional furnace which will double their capacity.

THE POTOMAC GLASS COMPANY, Cumberland, Md., is erecting an addition to its plant at a cost of $125,000. The new structure will be two stories high, 196 by 45 feet and of brick, steel and concrete construction. A new ten-pot furnace and four new tempering lehrs will be installed. The company is also installing a new etching plant which will be double the size of the present one.

The Douchamp blowing machines in the INTERSTATE WINDOW GLASS COMPANY'S plant at Smethport, Pa., are being dismantled, according to press reports. The Interstate company has an agreement with the American Window Glass Company to use the machines of the latter concern and it is expected the Smethport plant will be enlarged and equipped with these machines. The plant has been idle for more than a year.

THE JEANNETTE WINDOW GLASS COMPANY, Point Marion, Pa., is erecting a sheet glass works at Fairchance, Pa., which officers of the company say will cost close to $1,000,000 including machinery. Jules J. Quertinmont, president of the company, states that they expect to be making sheet glass by the Fourcault machine method by next October.

Furnaces have been lighted in the new factory of the AMERICAN THERMOS BOTTLE COMPANY, at Huntington, W. Va., which hereafter will furnish the glass blanks for the bottles made at the main plant in Norwich, Conn. The company is planning to double the size of the Huntington plant and expects to manufacture the complete thermos bottles, at this plant instead of only blanks.

Officials of the GENERAL ELECTRIC COMPANY, Schenectady, N. Y., deny a report which was published in a Toronto, Ontario, paper to the effect that the company was considering a proposition to acquire an idle paper mill at South Glens Falls, near Toronto, and turn it into a glass factory for the production of bulbs, search lights, etc. The company states that neither of their lamp works know anything of the matter and that the report is incorrect.

The following directors were elected at the annual meeting of the stockholders of the MONSANTO CHEMICAL WORKS, St. Louis, Mo.: John F. Queeny, Edgar M. Queeny, Theodore Rassieur, Gaston Du Bois, H. O. McDonough, J. D. Lumaghi and J. R. Goddall and the following officers were also elected: John F. Queeny, chairman of the board; Gaston Du Bois, president; H. O. McDonough, vice-president; W. R. Phemister, treasurer; Edgar M. Queeny, secretary and C. A. Zacher, assistant secretary.

THE SOUTHERN BOTTLE MANUFACTURING COMPANY, which was organized some time ago at Tampa, Fla., has been completely reorganized and the name has been changed to the Tampa Glass and Bottle Manufacturing Company. The officers of the reorganized company are Perry G. Wall, president; G. A. Miller, vice-president; Ernest Kreher, secretary and treasurer, and R. L. Rundell, general manager. For the present the company will manufacture bottles, but they expect to start manufacturing window and plate glass in the near future.

THE RATHBUN JONES ENGINEERING COMPANY, Toledo, Ohio, has appointed the Ingersoll-Rand Company, New York, general sales agent for Rathbun Gas Engines. Rathbun gas engines are well known to the trade as they have been in successful operation for over twenty years driving compressors, pumps and other machinery. They are of the vertical, multi-cylinder type and are built to operate on natural, illuminating, producer, coke oven, oil still and other forms of gases which can be successfully handled in an internal combustion engine. Sizes range from 100 brake horsepower to 1,450 brake horsepower.

THE WARE GLASS COMPANY, San Francisco, Cal., it is reported, has been organized to promote the business on the Pacific Coast and in intermountain territory of glassware manufacturers. The organizers are W. H. Wiseman, T. E. Frederickson and H. H. Ware. The headquarters of the company will be at 268 Market street. It is stated that the Ware Glass Company represents the Monongah Glass Company, Thatcher Manufacturing Company, Obear-Nestor Company, Gayner Glass Works, Vineland Scientific Glass Company, Vineland Flint Glass Works, Columbia Glass Works, Pittsburgh Lamp, Brass & Glass Company, Midwest Box Company and the Williams Sealing Corporation.

The Ohio Central Glass Company, 2420 Spring Grove avenue, Cincinnati, O., incorporated in October, 1921, to manufacture beveled mirrors, automobile curtain lights, rear vision mirrors, spirit levels, optical lenses and glass specialties, has increased its capitalization from 500 shares of no par value to 1,000 shares of no par value. The factory is equipped with special machinery for automatically beveling ovals, circles or other difficult designs. Conspicuous among the equipment is the Fosdick automatic beveling and polishing machine said to be the only machine which will automatically bevel and polish glass in other shapes than circles. R. E. Fosdick, factory manager, states that the factory is working to full capacity and is expected shortly to be operating on a 24-hour basis.

Inquiries Received

Further particular may be obtained from THE GLASS INDUSTRY.

61. Which is the best automatic bottle machine for use in Japan and where can it be seen in operation?

Foreign Trade Opportunities

Further particulars may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C.

1078. A merchant in South Africa desires to secure an agency for the sale of glass jars of all kinds, wide-mouth fruit jars, bottles, ointment pots of opal glass, jar rubbers, and raw and refined sulphur in rolls. Quotations should be given f. o. b. New York.

National Foreign Trade Convention.—More than one hundred practical experienced foreign trade advisers, not theorists, but men who have been chosen for what they have already accomplished, will be at the service of visitors who attend the Ninth National Foreign Trade Convention in Philadelphia, Pa., May 10, 11 and 12, 1922. They will be prepared to answer, without charge, any questions that may be put to them about foreign markets, shipping, finance, sales and advertising methods, and anything else that may be troubling those who desire to sell their products abroad.

Experts agree that permanent prosperity for America is dependent upon a healthy growth of our foreign trade, and that expansion of our export business is necessary to absorb the twenty per cent difference between domestic production and domestic consumption.

The convention has been called by James A. Farrell, president of the United States Steel Corporation, who is chairman of the National Foreign Trade Council, and thousands of the ablest business men of the country are expected to be present.

Production of Bottles and Illuminating Glassware.—Department of Commerce figures derived from production reports of the National Bottle Manufacturers' Association and the Illuminating Glassware Guild show a decrease in bottle production during the month of January, 1922, of 3½ per cent from December production. The index number for January is 83, compared with 86 in December, 100 for the whole year 1921, and 106 for the year 1920.

An increase of 4 per cent in net orders placed for illuminating glassware is recorded for January, 1921, over the preceding month, the index numbers for this item being for January, 1922, 108; December, 1921, 98; November, 137, and May, 133. Actual production of illuminating glassware in January, 1922, was 18 per cent below December production and shipments billed in January were 23 per cent below December.

"American Shop Plan" Refused.—Approximately 9,000 employees of the General Electric Company, Schenectady, N. Y., by a vote of almost two to one, refused to adopt a plan that was presented to them for workers' representation in the affairs of the company. Had the plan been accepted the plant would have been divided into sections and election districts and committee members elected by ballot.

Japanese Unemployment Allowances.—Thirty-one glassworkers of the Asahi Glass Company, Tobata, Fukuokaken, Japan, who were dismissed last fall owing to dullness in the glass market, have been granted discharge allowances to the amount of $17,113 to be divided among them. This is reported to be the largest award of the kind ever made in Japan.

Lower Freight Rates to the Northwest.—A reduction in rates on glass bottles and fruit jars from Muncie, Ind., to the Pacific northwest, to take effect May 5, has been announced by the Northern Pacific Railway, according to published reports.

Current Prices of Glass-Making Materials

From quotations furnished by various manufacturers and dealers

March 27, 1922

	Carlots	Less Carlots
Aluminum hydrate.....lb.	.05½	.06
Aluminum oxide.....lb.	..	..
Antimony oxide .....lb.	.08	.08
Arsenic trioxide (dense white, 99%) .....lb.	.07–.07½	
Barium carbonate .....ton	50.00	65.00
Barium hydrate .....lb.	..	..
Bone ash .....lb.	.05½	.06½
Borax .....lb.	.05¼–.05½	.05½–.06
Borax, fused, any mesh .....lb.	.19	.20
Boric acid, fused .....lb.	.35	.35
Cadmium Sulphide, red or orange.lb.		1.50
Cadmium Sulphide, yellow.....lb.		1.50
Cobalt oxide .....in bbls. per lb.		2.00
Cobalt oxide .....in 10 lb. tins, lb.		2.10
Copper oxide, red .....lb.		.17 –.20
Copper oxide, black .....lb.	.23	.26
Copper oxide, black, prep'ed, ...lb.		.30
Cryolite .....lb.		.09½
Feldspar, 100 mesh.....ton	15.00	
Fluorspar, powdered white, 95% .....ton	35.00	
90% .....ton	33.00	38.00
Kaolin .....ton	17.00	25.00
Lead oxide (red lead, Pb_3O_4)...lb.	.08	.08¼
Litharge (PbO) .....lb.	.07½	.07¾
Lime—		
Hydrated (in 50 lb. paper sacks) ton	10.50	
Burnt, ground, in bulk.....ton	7.25	
Burnt, ground. in paper sacks.ton	9.25	
Burnt, ground, in 280 lb. bbls. per bbl.	2.00	2.05
Manganese (85% MnO_2).....lb.	.04½	.05 –.06½
Nickelic Oxide (NiO) black....lb.	.45	.50
Nickelous Oxide (Ni_2O) green..lb.	.50	.55
Potassium carbonate—		
Calcined 90% .....lb.	.06	.07
Hydrated 90% .....lb.	.06½	.08
Potassium nitrate .....lb.	.07½	.08
Powdered blue .....lb.		.24 –.26
Powdered blue (std. formula) ..lb.		.38
Salt cake, glassmakers, f. o. b. works .....ton	21.00	.01½–.02 lb.
Selenium .....lb.		1.95–2.25
Soda ash, 58% dense, 48% basis		
Bulk, ...100 lb.	1.27½	1.37½
Bulk, on contract .....100 lb.	1.17½	
Sodium nitrate, refined.....lb.	.04½	.05
Sodium selenite .....lb.		2.25–3.05
Sulphur (flowers) .....lb.	.02¼	.02¾–.03
Sulphur (flour, heavy) .....lb.	.02	.02½
Uranium Oxide—100 lb lots.....lb.	2.10	2.25
Zinc oxide (ZnO) .....lb.	.08	.09–.11¼

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

Pittsburgh Stock Exchange—March 25, 1922

	Bid	*Asked*	*Last*
American Window Glass Machine common	78½	80	80
American Window Glass Machine pfd.....	89	90	90
American Window Glass preferred.....	100	101	101
Pittsburgh Plate Glass.....	140	142	140½
U. S. Glass.....	43	47	43

Glass stocks very strong and active on Pittsburgh market past month. Both American Window Glass Machine common and Pittsburgh Plate Glass are up about ten points since last report. Both stocks sold ex-dividend March 14th, Pittsburgh Plate Glass selling ex-dividend $7.00, the company having declared a $5.00 extra dividend in addition to their regular $2.00 quarterly. The stock sold as high as 147½.

Wheeling Stock Exchange—March 27, 1922

	Bid	*Asked*	*Last*
Hazel-Atlas Glass.....	144	145	145
Fostoria Glass	115	120	115
Central Glass	100	125	125
Imperial Glass	95	100	100

Hazel-Atlas Glass scored a ten point gain this month on the Wheeling Stock Exchange. Business of the company is reported very satisfactory with indications that 1922 will be a splendid year. Imperial Glass Company passed its quarterly dividend. According to statement of an official of the company, the dividend was earned but the directors deemed it prudent to conserve cash resources.

Toledo Stock Exchange—March 28, 1922

	Bid	*Asked*	*Last*
Owens Bottle Machine common.....	32	32½	32½
Owens Bottle Machine preferred.....	95	102	100
Libbey-Owens Sheet Glass common.....	116	125	117
Libbey-Owens Sheet Glass preferred.....	98	102	100

Market strong and active with a jump of about twenty points in Libbey-Owens Sheet Glass common.